SEX DIFFERENCES IN THE PERFORMANCE OF DEAF CHILDREN ON THE WISC-R PERFORMANCE SCALE

BY

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This study investigated sex differences in the performance of deaf children on the Wechsler Intelligence Scale for Children-Revised (WISC-R) by analyzing the data collected by Anderson and Sisco during the standardization of the WISC-R, Performance Scale for deaf children. The deaf sample consisted of 669 males and 536 females, ranging in age from 6-0-0 to 16-11-30. The sample was well balanced with respect to the background variables controlled by Wechsler in the WISC-R standardization. The data were analyzed using the Statistical Analysis System 79.5 at the Northeast Regional Data Center in Gainesville, Florida.

It was hypothesized that there would be no significant sex differences in the performance of deaf children on the WISC-R Performance Scale. Six of nine hypotheses tested were rejected. Significant sex differences were found in the performance of deaf children on subtests; deaf males scored

significantly higher than deaf females on Block Design, Object Assembly and Picture Completion while deaf females were superior on Coding. Variables such as age and the interaction of sex and age were found to affect subtest performance. Deaf males and females both differed significantly from hearing males and females in Wechsler's standardization sample. Deaf females scored below deaf males on all subtests except Coding. No significant sex differences were found in overall Performance Intelligence Quotients (PIQ), in the factors of intelligence, the intercorrelations of the WISC-R performance subtests or the correlational patterns of the performance subtests with PIQ's. Deaf children's performance on subtests were found to be more consistent with their total IQ pattern than Wechsler's standardization sample.

It was concluded that there is no overall significant sex bias in the WISC-R, Performance Scale and it can be used with deaf as well as hearing children, regardless of sex, to obtain a valid estimate of their nonverbal cognitive abilities. Significant differences in subtest score patterns were found and these must be taken into consideration in test interpretation and in educational and vocational planning. Additional research should be directed towards identifying factors that lead to sex differences in subtest performance.

CHAPTER I

INTRODUCTION

Are there sex differences in the cognitive abilities of deaf children? If so, are these similar to sex differences found in the general population? This research helps clarify these questions by reporting the results of an in-depth analysis of sex differences in performance of deaf children on the Wechsler Intelligence Scale for Children Revised (WISC-R). This analysis was based on data collected by Anderson and Sisco (1977) during the Standardization of the Performance Scale of the WISC-R for the Deaf.

Sex Differences Within the General Population

General Differences Between the Sexes

Historically, there has been considerable interest in differences in the development of males and females. Studies have shown sex differences in many areas of development with males generally showing the greatest variability. Males have been reported to have greater physical vulnerability than females: more males are stillborn and miscarried and die of infant diseases (Goetz, 1977; Maccoby and Jacklin, 1974); more males have brain injury at birth, as well as blindness, color blindness and deafness (Sexton, 1969; Singer Westphal and Niswander, 1968; Maccoby and Jacklin, 1974).

More males have also been reported in every category of exceptionality, except trainable mental retardation (Mumpower, 1970). Studies have reported more gifted males than gifted females, at a ratio of approximately 3:1, and more retarded males than retarded females, at a ratio of approximately 2:1 (Mumpower, 1970; Singer and Osborn, 1970; Werner, Bierman and French, 1971). More males than females have also been identified as having behavioral problems (Kelly, Bullock and Dykes, 1977; Spence, Simmons, Brown and Wikler, 1973; Bakwin and Bakwin, 1972; Morse, Cutler and Fink, 1964) and more males have been diagnosed as hyperactive (Miller, Palkes and Stewart, 1974). A greater number of males have been identified as learning disabled (Emery, 1973) and as having significantly more reading problems than females (Levine and Fuller, 1972; Money, 1966). Reasons suggested for males apparent greater vulnerability and variability include genetic factors (males do not have suppressor genes to counteract the effects of recessor genes), obstetric problems related to genetics which result in males being more sensitive to adverse prenatal environments, faster physical development of females which may reduce their susceptibility to fetal and environmental damage, and social factors which result in different expectations and criteria for males and females (Maccoby and Jacklin, 1974; Singer, Westphal and Niswander, 1968).

Maccoby and Jacklin (1974) conducted a comprehensive review of the literature to determine which of the widely held beliefs about sex differences were supported by evidence and which were myths or as yet untested. A brief summary of some of their findings is presented below; the reader is referred to Maccoby and Jacklin's book for in-depth discussion of the research in this area.

Maccoby and Jacklin (1974) identified the following four relatively well established sex differences supported by numerous research studies: (1) females were found to have generally greater verbal ability; (2) males excelled in visual-spatial ability; (3) males excelled in mathematical ability; and (4) males were more aggressive. They did not find sufficient evidence to support beliefs such as males are more analytic, females are auditory and males are visual learners, females are better at rote learning and simple repetitive tasks while males are better at tasks that require higher level cognitive processing and the inhibition of previous responses, females lack achievement motivation and have lower self-esteem than males, females are more "suggestible" than males, females are more social than males, and females are more affected by heredity and males are more affected by environment. In general, the sexes were not found to differ on tests of analytic or cognitive ability (or style) and males and females were found to be

equally proficient at discrimination learning, reversal shifts, probability learning and in ability to respond to relevant task aspects. At most ages, males and females were equally adept at discriminating speech sounds and no sex difference was found in memory for sounds previously heard. The two sexes were found to be equally interested in social stimuli and equally proficient at learning through imitation of models. Both sexes were equally susceptible to "suggestions" or persuasive communications. Females were not found to have lower self-esteem but there were some qualitative differences between the sexes in terms of the area of functioning where they had the greatest confidence and self-esteem. Females rated themselves higher in the area of social competence while males more often rated themselves as obtaining greater confidence and self-esteem from being strong, powerful, dominant and potent. Overall, the sexes were found to be highly similar in their overall self-satisfaction and self-confidence throughout childhood and adolescence. Maccoby and Jacklin's work emphasizes the need for continued investigation of sex differences to help eliminate myths and unsubstantiated beliefs. Information obtained through such research would provide a more accurate picture of the "real differences" between the sexes.

Sex Differences in Cognitive Functioning

Considerable research effort has been directed towards assessing sex differences in intellectual growth and

development. Bayley (1968) investigated differences in the mental, physical and emotional trends of development of the sexes in a longitudinal study of 61 newborns who were tested and retested in numerous areas over a period of fifty or so years. In the area of intellectual development she found that the IQ was not constant, that the components of intelligence changed with age and that intellectual growth may continue throughout life. Significant differences were found in the pattern of correlation of mental growth and in behavior correlates between males and females. Females' mental ability was found to stabilize at an earlier age than males' and females' intelligence was generally independent of personality and behavioral variables. Males' mental abilities stabilized later in life and were far more bound to behavioral and personality variables than females'. Based upon her work, Bayley concluded that the cognitive as well as the emotional processes of males and females differ and must be taken into account in the experimental design of studies and in the statistical analysis of data.

In studies dealing with measures of general intelligence, generally, no systematic differences in the overall or composite IQ scores of males and females have been found (Speck, 1978; Astin, 1975; Williams, 1975; Maccoby and Jacklin, 1974; Cattell, 1971; Maccoby, 1966). A tendency for females to earn higher scores on general tests of intelligence during the preschool

years and for males to earn higher scores during the high school years have been reported (Fedrickson, 1977; Maccoby, 1966; Maccoby and Jacklin, 1974; Prosser and Crawford, 1971; Gillingham, 1970).

While males and females have not generally been found to differ significantly in their overall or composite IQ scores, studies have consistently reported the sexes to differ in terms of specific abilities and subtest performance. Factor analytic studies of general intelligence have generally found that the structural components of intelligence vary be sex and often by age (Silverstein, 1980; Ahrens, 1978; Williams, 1975; Very and Iacono, 1970; Cattell, 1971; Anastasia, 1968; Very, 1967). Sex differences in subtest performance on the Wechsler Intelligence Scale for Children (WISC) have been reported by Howe (1977), Lyle and Johnson (1974), Holowinsky and Pascale (1972), Solkoff (1972), Quereshi (1968), and Miele (1958). Vance (1979), Vance et al. (1978), Bradberry, Wright, Walker and Ross (1975) report considerable sex differences in performance of retarded children on the Wechsler Intelligence Scale for Children-Revised (WISC-R). Alper (1967) also reported sex differences in subtest scores for retarded children on the WISC. Hall (1980) and Karnes and Brown (1980) found significant sex differences in subtest scores on the WISC-R for gifted children. Sex differences in subtest scores on the Wechsler Adult Intelligence Scale have been

reported by Rosen (1975); Herrans (1969); Silverstein and Fisher (1960); Wechsler (1958); and Miele (1958). Significant sex differences on the Coding subtest favoring females have been reported by Howe (1977) and Lyle and Johnson (1974).

Intellectual Assessment of the Deaf

Research findings regarding the performance of deaf children on intelligence tests have varied. Early studies reported the deaf to be inferior to the hearing in their performance on tests of intelligence (Pintner, Eisenson, and Stanton, 1946; Zeckel and Van der Kolk, 1939; Pintner and Reamer, 1920, etc.). Subsequent studies found the deaf displayed average intelligence when individual performance tests of intelligence were used to assess their cognitive abilities (Myklebust, 1964; Graham and Shapiro, 1953; Myklebust and Burchard, 1945; Streng and Kirk, 1938). In 1968, Vernon reviewed the previous fifty years of research in this area and concluded that the intellectual functioning of deaf individuals approximates the same range of ability as demonstrated by the hearing population. Subsequent studies by Moores, Weiss, and Goodwin (1976), Vonderhaar and Chambers (1975) and Brill (1969) have reported superior performance IQ scores for the deaf (when compared with the hearing population). Superior IQ scores for deaf children of deaf parents when compared with their hearing or deaf peers were also reported by Sisco and Anderson (1980) and Brill (1969).

Using a national sample of 1228 deaf children attending deaf and day schools located throughout the United States, Anderson and Sisco (1977) found a significant difference (beyond the .01 level) on the WISC-R between their deaf sample and Wechsler's (1974) hearing sample in terms of mean performance IQ scores, standard deviations and subtest scaled patterns. Deaf children performed similar to hearing children on all performance subtests except Coding and Picture Arrangement, where they scored significantly below their hearing peers. Their highest scores were on the Object Assembly subtest, where they scored slightly higher than their hearing peers. This was consistent with the findings of Myklebust (1964), Goetzinger and Rousey (1957), and Levine (1956). In other studies Levine (1956) and Goetzinger and Rousey (1957) found the deaf's lowest score to be on the Picture Completion subtest while Myklebust (1964) found their lowest score to be on the Coding subtest. Vonderhaar and Chambers (1975) found deaf subjects exhibited a significant strength on Object Assembly but a significant weakness on Picture Completion. Vonderhaar (1977) reported deaf children's highest scores to be on the Object Assembly subtest; his results suggested that the Object Assembly and Block Design subtests are the most stable of the performance subtests for the deaf, and conversely, the Coding and Picture Completion the most variable of the performance subtests.

Sex Differences in the Cognitive Functioning of the Deaf

Significant sex differences in subtest scores and patterns on the Wechsler Performance Scales have been reported by Vonderhaar and Chambers (1975) and Vonderhaar (1977). Vonderhaar and Chambers (1975) found deaf males scored significantly higher on the Object Assembly subtest and lower on the Picture Completion subtest; females were strong on Object Assembly, weak on Picture Arrangement and showed no difficulty with Coding.

In a comparative study of the performance of deaf children on the WISC and WISC-R, Vonderhaar (1977) found significant sex differences on three of the five performance subtests. Males exhibited significant differences between the two tests on the Picture Completion and Coding subtests while females demonstrated significant differences between the two tests on the Picture Arrangement, Block Design, and Coding subtests. The sexes showed no significant differences between their performance on the WISC and WISC-R Object Assembly subtest. Both sexes scored higher on the Picture Arrangement subtest on the WISC-R and this was significant for females but not for males. Males received significantly higher mean performance IQ scores on both the WISC and WISC-R. Males also received higher mean subtest scaled scores on all subtests of the WISC and WISC-R, except Coding where females scored higher on both tests.

Rationale of the Study

Research previously reported indicates sex differences in cognitive abilities have been found in the deaf as well as the hearing population. The Wechsler Intelligence Scale for Children is one of the most widely used tests of mental ability with deaf and hearing children (Sattler, 1974; Levine, 1974; Vernon, 1974). The Wechsler Intelligence Scale for Children (WISC) and the Wechsler Intelligence Scale for Children-Revised (WISC-R) have five subtests from which a Verbal IQ can be derived and five subtests from which a Performance IQ can be derived. The verbal subtests are considered to be inappropriate with the deaf because of the deaf persons's language and communication handicaps. According to Vernon (1974) and others, verbal tests used with the deaf generally measure their language deficiency due to hearing loss rather than their intelligence and reflect their communication disability rather than their intellectual capabilities (Vernon, 1974; Brill, 1969; Vernon, 1968; Levine, 1960; Myklebust, 1964). To be a valid measure of the intellectual abilities of deaf individuals, an intelligence test must be a non-verbal, performance-type instrument (Anderson and Sisco, 1977; Vernon, 1974; Brill, 1969). The Performance Scale of the Wechsler Intelligence Scale has been reported to be the most widely used test of mental ability with deaf individuals (McQuaid and Alovisetti, 1981; Levine, 1974; Vernon, 1974). The reliability of the

WISC-R Performance Scale with the deaf has been established by Hirshoren, Kavale, Hurley and Hunt (1977) and Hirshoren, Hurley and Kavale (1979).

Vonderhaar and Chambers (1975) and Vonderhaar (1977) studies indicate the need for a more extensive investigation of sex differences in the performance of deaf children on the WISC-R Performance Scale. This is particularly true in the light of recent federal and state legislation (such as Public Law 94-142) which requires that educational, vocational and personal planning for students be consistent with their measured abilities.

The present study seeks to help clarify sex differences in deaf children's performance on the WISC-R Performance Scale by providing an in-depth analysis of the data collected by Anderson and Sisco (1977) during the Standardization of the WISC-R, Performance Scale for Deaf Children. Analysis of sex differences in the performance of deaf children on the WISC-R, based on such a large national sample would help substantiate previous findings and increase the reliability and generalizability of previous results; it would also facilitate more appropriate educational, vocational, and personal planning for deaf children. Vonderhaar and Chambers (1975) and Vonderhaar (1977) studies were characterized by relatively small sample sizes (N = 55, 29 females, 26 males; N = 73, 31 females, 42 males, respectively) and their findings may or may not be

representative of the general deaf population. Anderson and Sisco (1977) WISC-R normative sample was large (N = 1228) and well balanced with respect to the background variables controlled by Wechsler (1974) in the WISC-R standardization, namely, sex, region, race, residence and parental occupation. The deaf norms, specific subtest findings and a complete description of the standardization process are reported in the Gallaudet College Office of Demographic Studies Publication, Series T, Number 1 (Anderson and Sisco, 1977).

Definitions and Abbreviations

1. Deaf child--a child who is congentially or prelingually deaf and has a hearing loss of 70 dB or greater (pure tone average in the better ear).
2. W-B--Wechsler-Bellevue Test.
3. WPPSI--Wechsler Preschool and Primary Scale of Intelligence.
4. WISC--Wechsler Intelligence Scale for Children.
5. WISC-R--Wechsler Intelligence Scale for Children-Revised.
6. WAIS--Wechsler Adult Intelligence Scale.
7. WAIS-R--Wechsler Adult Intelligence Scale-Revised.
8. VIQ--Verbal (Scale) Intelligence Quotient.
9. PIQ--Performance (Scale) Intelligence Quotient.
10. FSIQ--Full Scale Intelligence Quotient.
11. CA--Chronological Age.

CHAPTER II

REVIEW OF THE LITERATURE

Chapter I presented general information regarding sex differences in the cognitive functioning of deaf and hearing children. The Performance Scale of the Wechsler Intelligence Scales has been reported to be the most widely used test of mental ability with deaf individuals (McQuaid and Alovisetti, 1981; Levine, 1974; Vernon, 1974). This chapter presents a review of the literature that focuses on studies investigating sex differences in the performance of hearing and deaf individuals on the Wechsler Performance Scales of Intelligence.

Sex Differences Within the Hearing Population

Most studies dealing with measures of general intelligence, using the Wechsler Scales as well as other measures of intelligence, have reported no systematic difference in the overall or composite scores of males and females in the hearing population (Speck, 1978; Astin, 1975; Williams, 1975; Maccoby and Jacklin, 1974; Cattell, 1971; Maccoby, 1966). As previously indicated, however, some studies have found that females tend to earn higher scores on tests of intelligence during the preschool and early school years while males earn somewhat higher scores during the high school years (Fedrickson, 1977; Gillingham, 1970; Maccoby, 1966). That the sexes would generally

show similar overall or composite scores on the Wechsler scales, however, is not unexpected due to the methods used in the development of the tests. The Wechsler scales were developed so that IQ's are standard scores and the mean IQ's (VIQ, PIQ and FSIQ's) and standard deviations at each age level are equal. Each subtest has a mean scaled score of 10 and a standard deviation of 3. Fifty percent of the standardization samples were males and fifty percent were females; an equal number of males and females were included at each age level in the standardization samples. Because of the equal distribution of the sexes, it was generally assumed that sex as a variable was controlled in the development of the Wechsler scales. Wechsler (1949, 1974) provided no comparative data between the sexes in either manual. The general assumption that sex as a variable was controlled on the Wechsler scales may partially account for the relatively few studies within the general, hearing population that have investigated sex differences in performance on the Wechsler tests. Gilford (1967) reported that failure to take into account sex as an experimental variable may confound the data and obscure sex differences in the underlying abilities of intelligence. Williams (1975) also pointed out that sex differences in special abilities may account for some of the observed differences in levels of performance on intelligence tests, including the Wechsler scales. Factor analytic studies and studies

of sex differences in subtests performance were undertaken to help clarify sex differences in intellectual abilities as measured by the Wechsler Scales.

Factor-Analytic Studies

The Wechsler Intelligence Scales have been the subject of several major factor analytic studies. Verbal and non-verbal factors appear consistently in all studies reported on the WISC and WISC-R (Anastasi, 1976; Williams, 1975; Wechsler, 1974).

Cohen (1959) factor analyzed the WISC standardization data (Wechsler, 1949) at three age levels (7½, 10½ and 13½). He identified five major factors on the WISC: Verbal Comprehension I, Perceptual Organization, Freedom from Distractibility, Verbal Comprehension II, and a quasi-specific factor related to Coding and Picture Arrangement. Kaufman (1975) provided a similar factor analysis of the WISC-R standardization data for 11 age groups (6½ through 16½). He identified three major factors of intelligence on the WISC-R: Verbal Comprehension, Perceptual Organization and Freedom from Distractibility. The results of Kaufman's study supported Cohen's 1959 findings as well as Wechsler's (1974) Verbal Performance factors. Silverstein (1977) using the WISC-R standardization data replicated Kaufman's methodology and confirmed his results. No comparative data between the sexes were provided by Wechsler in the WISC or WISC-R manuals

(Wechsler, 1949, 1974, respectively) nor by Cohen, Kaufman or Silverstein.

Ahrens (1978) conducted a factorial analysis of sex and age differences in performance on the WISC-R using a sample of 150 males and females at ages 7½, 9½ and 11½. She found the structural components of intelligence as measured by the WISC-R varied by sex and age. Females at the different age levels appeared to show earlier maturity in factorial structures beginning with "g"; this earlier maturity of the females continued throughout the definition of other factors. Within the non-verbal, performance areas, differences between males and females in the experimental groups were not clearly demarcated until the 11½-year-old level. Differences favoring visual-motor planning ability were more consistent for the males across age levels. Differences between the sexes in visual-motor and speed skills (favoring females) emerged at 9½ years of age in the female sample and were clearly established by 11½ years of age. Memory and Sequential Memory factors identified for 11½-year-old males and females suggested that auditory and visual memory skills become integrated for both sexes at the 11½-year-old level.

Using the WISC-R standardization data, Reynolds and Gutkin (1980) factor analyzed the intercorrelations of the 12 WISC-R subtests separately for males and females at two age levels. He divided the WISC-R sample into four groups: females, age 6-10 (N = 500); males, age 6-10 (N = 500);

females, age 11-16 (N = 600); males, age 11-16 (N = 600). He found the three factors identified by Kaufman (1975), namely, Verbal Comprehension, Perceptual Organization and Freedom from Distractibility, appeared consistently within each group in his study. The order in which the factors appeared in all groups, except for the group of males between 6 and 10 years of age, were Verbal Comprehension, Perceptual Organization and Freedom from Distractibility. For the group of males between 6 and 10 years of age the Perceptual Organization factor appeared before the Verbal Comprehension factor. In general, they found consistently high coefficients of congruence and concluded that the WISC-R factor structure was essentially invariant with regard to sex and age.

Speck (1978) investigated sex differences in the factorial structure of 200 gifted children as measured by the WISC-R. Her sample consisted of 100 males and 100 females between the ages of 9 and 10½ years; the 9-10½-year-old age group was selected because it had been reported by Bayley (1965) to be a period of psychosocial quiescence. Data were subjected to both raw score and scaled analyses for sex differences. She found sex differences existed in the factorial structure of males and females on the WISC-R and that total sample analysis differed in structure for raw and scaled score analyses and obscured the sex differences that existed in separate analyses. She found a significant difference between males and females

on Verbal IQ (favoring females) which was consistent with previous research expectations. No significant difference was found between males and females in terms of mean PIQ or mean FSIQ scores. On the Performance subtests, significant differences between the sexes were found on the Coding and Block Design subtests. Females scored significantly higher than males on the Coding subtest, using raw and scaled score analysis. Males performed significantly better than females on the Block Design subtest, on scaled score analysis only.

In the Speck study, factor comparisons for males and females showed different factor loadings on different subtests. With raw score analysis, a Memory-for-Systems factor was found to be specific to males on the Arithmetic, Block Design, and Coding subtests; a General Evaluation Factor (ability to foresee consequences and implications) was specific to females and found primarily on the Mazes and Comprehension subtests. Females showed significant loadings on Object Assembly and Coding. Picture Completion and Coding were never included in any of the male factor raw score analysis. When scaled score analysis was used, different subtests were found to contribute significantly to different factor loadings for males and females. Factors identified included Verbal factor, Perceptual-Evaluation factor, Memory-for-Systems factor and a Specific Non-verbal factor. Block Design and Object Assembly contributed to loadings on the Perceptual-Evaluation factor for both males

and females while Coding contributed to the loadings on this factor for females only. Block Design also contributed to the factor loading on the Specific Non-verbal factor for females only. Picture Arrangement contributed to the factor loadings for the Verbal factor for females only. The Memory-for-Systems factor was common to both males and females but the Block Design and Arithmetic subtests contributed to this factor's loadings for males while Digit Span and Mazes contributed to the factor's loading for females.

Subtest Studies

Some investigations have focused on sex differences in subtest performance on the Wechsler Performance Scales.

Quereshi (1968) investigated the effect of experimentor's sex, subject's sex and subject's age on the WISC subtest scores and IQ estimates for 240 children between the ages of 5 and 14. He found a significant interaction effect between the examiner's sex and subject's sex on the Coding subtest and Performance IQ score. Significant differences (.05 level and beyond) were found between the sexes on the Coding subtests; females performed significantly better on Coding, regardless of the examiner's sex, but performed even better when the examiner was a male. Significant interaction effects for examiner's sex and subject's age were found on the Picture Arrangement subtest.

Holowinsky and Pascale (1972) investigated sex differences in the performance of 89 males and 45 females on the WISC. Subjects had a mean IQ of 79.55, standard deviation of 12.52 and IQ range of 57 to 129. He found on the Performance Scale of the WISC that males performed significantly better than females on the Picture Completion and Block Design subtests (.05 level).

Sex differences on the Wechsler Scales have also been reported for retarded and gifted children. An early study by Finley and Thompson (1959) found sex differences among retarded subjects approaching the 5% level of significance on the individual subtests of the Verbal Scale of the WISC. Subsequent studies by Alper (1967); Bradberry, Wright, Walker and Ross (1975); Vance (1979); Vance et al. (1978) reported sex differences for retarded subjects on the WISC and WISC-R on the Verbal and Performance Scales.

Alper (1967) analyzed the WISC subtest scores of 713 mentally retarded children between 5 and 16 years of age. He found males scores significantly higher than females on eight of the ten subtests. Females scored higher on the Coding subtest and both sexes scored about equally on the Similarities subtest. He also found that subjects scored higher on the Performance Scale than the Verbal Scale.

Bradberry, Wright, Walker and Ross (1975) investigated the effects of sex of examiner, sex of subject and age of subject on the performance of 511 retarded children (ages 6-0

to 14-11) on the WISC. They found sex of subject was significant (.05 level) and that retarded males consistently received higher scores than retarded females on all subtests. The performance of all children decreased with age with males generally performing better than females at all age levels. They concluded that for retarded or learning disabled children there is a significant difference in the way male and female subjects perform on the WISC.

Vance et al. (1978) used ANOVA to analyze the variation in subtest scores of 238 retarded children (135 males, 103 females) on the WISC-R. On the Performance Scale he found that females scored significantly higher on the Coding subtest. The greatest variation in subtest scores occurred on the Object Assembly subtest. In general, he found that for retarded subjects differences among the WISC-R subtests were as great within the verbal and performance areas as between them.

Vance (1979) investigated sex differences on the WISC-R of 126 retarded children (ranging in age from 7-3 to 8-3) who were matched in terms of WISC-R, FSIQ scores. He found no significant differences between the sexes in terms of Performance IQ, Verbal IQ, or Full Scale IQ. He did, however, find significant differences between subtest scores and a significant interaction effect between sex and subtest scores. On the Performance Scale, females obtained significantly

higher scores on Coding than did males. There were no significant differences between the sexes scores on Block Design, Picture Completion and Picture Arrangement. Males exceeded females on only one subtest--Object Assembly--but the mean score difference was not significant.

Using a sample of gifted students, Hall (1980) conducted an ex-post-facto study of sex differences in IQ development for 59 (29 males; 30 females) students attending the University School at Ann Arbor, Michigan. All subjects had IQ's over 130 and ranged in age from 6 to 18 years. IQ was determined by the Stanford-Binet scores from preschool through the seventh grade and Wechsler Intelligence scores from eighth grade through high school. Intellectually gifted females were found to outnumber males in the elementary grades as measured by scores on the Stanford-Binet but from the eighth grade through high school the trend reversed. Females increased and decreased in IQ scores more in high school than males; males were more stable and displayed a tendency to increase in IQ scores during high school. In elementary school both sexes experienced IQ changes in equal or near equal numbers. Increases in IQ during the elementary school years appeared to be related to the educational background of fathers, particularly for females. Significantly more females than males with fathers with Ph.D.'s increased in IQ scores; this suggested that highly educated fathers may be a contributing factor to high IQ development in females. On the Wechsler Scales, females were not found to be

significantly higher or lower on either the Verbal or Performance Scales but were significantly different from males in the amount of change on FSIQ scores. Hall did not report an analysis of sex differences in subtest scores for her gifted sample.

Karnes and Brown (1980) investigated sex differences in performance on the WISC-R of 946 gifted students ranging in age from 6 to 16 years. All subjects had an IQ score on the WISC-R greater than 120. Males obtained significantly higher (beyond .05 level) Verbal and FSIQ scores; the mean score difference on the Performance Scale approached significance, favoring females. On the Performance Scale, males scored significantly higher on the Block Design subtest, while females scored significantly higher on the Coding subtest. No significant differences between the sexes were found on other performance subtests. Karnes and Brown concluded that sex differences existed in the intellectual abilities measured by the WISC-R and that gifted males tend to manifest a higher level of verbal intelligence than gifted females; gifted males scored significantly higher than gifted females on the Information, Similarities, Vocabulary, and Comprehension subtests of the Verbal scale. The significantly higher mean performance score for females on the Coding subtest was consistent with the findings of previous research with retarded as well as normal children (Vance, 1979; Howe, 1977; Quereshi, 1968; Alper, 1967; Miele, 1958); this suggested that the abilities measured by the Coding

subtest are present to a greater extent in females, regardless of level of intelligence.

The Coding Subtest

The Coding subtests of the WISC and WISC-R have been the subject of several investigations. Factor analytic studies of the WISC and WISC-R have found the Coding subtest to load heavily on factors such as short-term memory (Baumeister and Bartlett, 1962), attention (Dennerll, Broeder and Sokolov, 1964), and verbal concept formation (Osborne, 1965). Maxwell (1959) factor analyzed the WISC standardization data (Wechsler, 1949) at three age levels (7½, 10½ and 13½) and found that Coding had significant loadings on a Verbal-Intellectual factor at all three age levels. Kaufman (1975) factor analyzed the standardization data of the WISC-R (Wechsler, 1974) at eleven age levels (6½ through 16½) and found Coding had significant loadings on the Freedom-From-Distractibility factor at seven age levels. He also found that Coding contributed 17% to general intelligence variance and Coding explained 18% of the variance of Freedom-From-Distractibility; these findings suggested that the Coding subtest may be a poor measure of general intelligence.

Howe (1977) investigated sex differences between Coding A (for children with a CA of less than 8 years) and Coding B (for children with a CA equal to or greater than 8 years) of the WISC-R subtests. Using "t" tests measures to determine

if the Coding subtest differed significantly from the next lowest performance subtest score and component factor analysis with varimax rotation of factors for complete data analysis, she found that for males, regardless of age, the Coding subtest score was significantly lower than the next lowest subtest score. Coding also loaded heavily on a Verbal factor for males. For females, regardless of age, the Coding subtest did not differ significantly from the next lowest subtest. Three principal factors emerged for females--two Verbal and one Perceptual-Performance. Coding loaded heavily on the Perceptual-Performance factor for females. She also found:

1. For children less than 8 years of age, the Coding A subtest score did not differ significantly from the next lowest subtest score. Coding for this group had low communality with the rest of the WISC-R, tending to load with the perceptual performance marker test (Bender-Gestalt).
2. For children 8 years of older, the Coding B subtest score differed significantly (beyond .05 level) from the next lowest subtest score in two of the three factor analyses. Coding B had low communality with the rest of the WISC-R, being identified by neither of the principal factors (Verbal factor or Perceptual-Performance factor).

3. Differences in the factor matrixes for the two groups of children (CA less than 8 and CA greater than 8) indicated that Coding A and Coding B on the WISC-R were not parallel forms of the same basic construct. Coding A tended to be associated with a Perceptual-Performance factor, while the Coding B factor was unidentified.

Howe's findings suggested that the Coding task may be perceived differently by males and females. For males, Coding loaded heavily on a Verbal factor suggesting that Coding is perceived more as a verbal, symbolic-language task by males. For females, Coding loaded heavily on a Perceptual-Performance factor suggesting that Coding is perceived more as a non-language, visual perception task by females. She also found that the perception of Coding as a symbolic language task as opposed to a non-language visual perception task may be age related as well as sex related; further investigation in this area is definitely needed.

Lyle and Johnson (1974) conducted an analysis of the WISC Coding subtest in relationship to writing speed and associate learning. They found that females scored significantly higher than males on the Coding subtest (beyond .01 level). If the WISC Coding subtest was transformed into scaled scores appropriate to the mean age of the group, the mean raw score would yield a scaled score of approximately 10 for males and 12 for

females. Using regression analysis, they also found that writing speed and associate learning were significant predictors of WISC Coding performance. Significant sex differences in favor of girls in writing speed and associative learning tasks were also reported by Johnson and Lyle (1972) and Johnson and Lyle (1973).

Wechsler Adult Intelligence Scales

The Wechsler Adult Intelligence Scale (WAIS) was "published in 1955 as an extension and modification of the Wechsler-Bellevue Test" (Wechsler, 1955, p. 4). The WAIS is the adult counterpart of the WISC and WISC-R. Sex differences in the performance of adults (16 years of age or greater) on the Wechsler scales have been reported but the findings have been somewhat inconsistent. A brief summary of some of the pertinent studies in this area follows.

The early studies looked at sex differences in the performance of psychiatric patients on the Wechsler-Bellevue Test. Strange and Palmer (1953) analyzed the performance on the Wechsler-Bellevue Test of 145 males and 90 females at a white, outpatient psychiatric clinic. Males were found to have significantly higher Performance, Verbal and Full-Scale IQ mean scores than females; males also scored significantly higher on all subtests except Digit Symbol (Coding subtest on the WISC and WISC-R), Picture Arrangement and Vocabulary. The findings of the Strange and Palmer study,

however, were questioned since differences in IQ functioning may have been the result of sample characteristics.

Goolishan and Foster (1954) investigated sex differences in the performance of 392 psychiatric patients on the Wechsler-Bellevue. They found males performed significantly higher than females on the Performance Scale, Verbal Scale and Full-Scale; on the Performance Scale they found significant differences in favor of males on the Picture Completion and Block Design subtests.

Norman (1953) investigated sex differences in the performance of 153 superior adults (IQ equal to or greater than 120) on the Wechsler-Bellevue after equating males and females on Full-Scale IQ. He found females scored significantly higher than males on the Performance Scale and males scored significantly higher than females on the Verbal Scale. Males received significantly higher scores on the Arithmetic subtest, while females scored significantly higher on the Digit Symbol (Coding) subtest.

Wechsler (1958) reported small, systematic but insignificant sex differences favoring males on the Performance Scale, Verbal Scale and Full Scale of the WAIS. On the Performance Scale, he found that males performed significantly better than females on the Picture Completion and Block Design subtests, while females performed significantly better than males on the Digit Symbol subtest. In 1960, Silverstein and

Fisher reanalyzed the standardization data of the WAIS using more refined statistics. On the Performance Scale they found that males performed significantly better than females on the Picture Completion and Block Design subtests, while females excelled on the Digit Symbol subtest. These findings were consistent with Wechsler's (1958) findings.

Miele (1958) investigated sex differences in performance on the WAIS and WISC, using the standardization data for the two respective tests. The data were analyzed with three factor analysis of variance techniques. He found no significant sex differences in terms of general intelligence on the WISC or WAIS but found significant sex differences in performance on subtests on both tests. On the Performance subtests, he found:

1. Males were superior to females on the Block Design subtest at all age levels except the very youngest (age 5) and the very oldest (age 55-64).
2. Females performed better than males on the Coding - Digit Symbol subtests at all age levels.
3. On the WISC, males performed consistently better than females at all age levels on the Mazes subtests and, after age 7, they performed better than females on the Picture Completion and Object Assembly subtests. Females performed significantly better than males on the Picture Completion subtest of the WAIS.

4. Performance on all WISC subtests was a positive function of age. On the WAIS, this positive function persisted to the 18-19 age group on the Performance subtests and to approximately the 25-34 age group on the Verbal subtests. All of the Performance subtests showed a sharp and radical decline in score with advancing age.

Using a sample of 200 subjects similar to Wechsler (1955), Rosen (1975) compared the WAIS subtest patterns of males and females in his sample with the patterns observed by Wechsler in the standardization sample. He found that for all age levels but one the PIQ, VIQ and FSIQ scores were higher for males than females; in the 35-44 age group, these scores were all higher for females. Significant differences between the overall means for males and females, favoring males, were found on only the Comprehension and Arithmetic subtests. He found no subtest on which females performed significantly better than males. Males and females declined in their scores on all eleven subtests with advancing age; when years of education was covaried the Arithmetic and Vocabulary subtests did not show significant declines. Some subtests declined more rapidly than others. The "hold" subtests which showed a less radical decline were Picture Completion, Object Assembly, Information, and Vocabulary. The "don't hold" subtests (showing more marked decline) were Digit Symbol, Block Design, Similarities, and Digit Span.

Bayley (1968) conducted a longitudinal study of 61 newborn infants who were tested and retested with a variety of tests, including the WAIS, over a period of fifty or so years. She found that females' ability stabilized at earlier ages, while males exhibited greater stability later in life. Intelligence test scores of females appeared to be relatively independent of personality variables while males' intelligence test scores appeared to be bound to personality and behavioral variables. For males, scores on tests of intelligence and behavior correlated throughout the first 18 years of life with maternal behaviors in the first three or four years of life, while females' intelligence test scores correlated more highly with parental ability.

On the Performance Scale of the WAIS, Bayley reported the Digit Symbol subtest to be the most stable subtest for females over the 16 to 36 year interval ($r = .64$) and to be the identifying scale in an independent female factorial dimension. For females, the Digit Symbol subtest was not only independent of the mental abilities scales but was also independent of behavioral variables at 16 and 36 years of age. She states, "This independence of both Digit Symbol scores and personality attributes raises the question whether for females the genetic determiners of intelligence may be relatively strong in this type of mental process" (Bayley, 1968,

p. 7). For males, the Digit Symbol subtest was strongly weighted in a factor which was moderately stable (16-36 year interval, r = .69) but was less independent of verbal factors. This as well as other findings led Bayley to conclude that the cognitive as well as the emotional processes for males and females differ and must be treated separately in all statistical analysis.

The above studies of adult intelligence suggests that sex differences in intellectual functioning identified in childhood may persist throughout life. Bayley's longitudinal study provides a great deal of support for this position. No studies of sex differences in the performance of deaf adults on the WAIS could be found. There appears to be a great need for research in this area within both the deaf and hearing populations. The Wechsler Adult Intelligence Scale-Revised was recently published (Wechsler, 1981). With the likelihood that the WAIS-R will replace the WAIS (in the same way the WISC-R is replacing the WISC), it would seem appropriate to direct studies toward assessing intra- and inter-sex differences in performance on the two tests of intelligence.

Sex Differences Within the Deaf Population

A review of the literature revealed two primary studies investigating sex differences in the performance of deaf children on the Wechsler Intelligence test: a study by

Vonderhaar and Chambers in 1975 and a study by Vonderhaar in 1977.

Vonderhaar and Chambers (1975) reviewed the psychometric profiles of 55 deaf adolescents (26 males and 29 females) with respect to their performance on the Wechsler Performance Scales. Subjects ranged in age from 15 to 19 years; five students were 15 years old and were evaluated with the WISC Performance Scale; the remaining students were evaluated with the WAIS Performance Scale. They found the difference between the sexes mean PIQ scores was not significant. Males mean scaled scores were slightly higher (though not statistically significant) than females on all performance subtests except Digit Symbol (Coding) where females scored significantly higher (.025 level). In general, males and females performed significantly higher (.01 level) than their overall mean ($\bar{X}$ = 10.43) on the Object Assembly subtest ($\bar{x}$ = 11.69) and significantly lower than their overall mean on the Picture Completion subtest ($\bar{x}$ = 9.84). Males scored significantly higher (.01 level) than their overall mean ($\bar{X}$ = 11.18) on the Object Assembly subtest and significantly lower (.01 and .025 levels respectively) on the Digit Symbol (Coding) and Picture Completion subtests. Females, on the other hand, had no difficulty with the Coding or Digit Symbol subtests but scored significantly below (.05 level) their overall mean performance score ($\bar{X}$ = 9.76) on the Picture Arrangement subtest.

In a comparative study, Vonderhaar (1977) examined the performance of deaf children on the WISC and WISC-R using a younger sample of children (age range 10-15 years). His subjects consisted of 42 males and 31 females attending one of three residential schools for the deaf located in California, Arizona and Colorado. He found the following significant differences between the WISC and WISC-R when administered to the same group of deaf children:

1. Deaf children, overall, scored significantly higher (.05 level) on the Performance Scale of the WISC than the Performance Scale of the WISC-R. The mean WISC Performance Scale IQ score was 4.2 points higher than the mean WISC-R Performance Scale IQ score.
2. Subtest comparison of the WISC and WISC-R showed that deaf children scored higher on four of the five performance subtests of the WISC. Significant differences (at .05 level or beyond) were found on three of the five performance subtests. On the WISC they scored significantly higher on the Coding and Picture Completion subtests; on the WISC-R they scored significantly higher on the Picture Arrangement subtest.

3. Pearson Product Moment correlations between the WISC and WISC-R were:

Performance Scale IQ	.76
Picture Completion	.64
Picture Arrangement	.50
Block Design	.74
Object Assembly	.55
Coding	.48

4. Analysis of sex differences revealed that each sex obtained a significant difference (.05 level or beyond) between the WISC and WISC-R mean PIQ's; males obtained higher IQ scores than females on both the WISC and WISC-R. The pattern of subtest differences between the two tests also differed by sex. Males obtained higher mean subtest scaled scores on all subtests of the WISC and WISC-R except the Coding subtest; females scored higher than males on the Coding subtests of both the WISC and WISC-R. Males exhibited significant differences (.05 level) between the WISC and WISC-R on the Picture Completion and Coding subtests, while females demonstrated significant differences (.05 level) between the two tests on the Picture Arrangement, Block Design and Coding subtests. The sexes showed no significant differences in their performance on the Object Assembly subtest; both sexes received

their highest mean subtest scaled score on the Object Assembly subtest on both the WISC and WISC-R. This is consistent with previous research findings which report that the deaf generally show a strength on the Object Assembly subtest. Both sexes scored higher on the Picture Arrangement subtest of the WISC-R; this was significant (.05 level) for females but not males.

Comparative Studies of the WISC and WISC-R

Comparative studies of the WISC and WISC-R have generally found significant differences in subjects' performance on the two tests of intelligence (Schwarting, 1976; Hamm et al., 1976; Rowe, 1976: Solway, 1976; Swerdlik, 1977; Thomas, 1977; Brooks, 1977). In general, the WISC-R has been reported to yield significantly lower (5 to 8 points) PIQ, VIQ and FSIQ scores than the WISC (Schwarting, 1976; Rowe, 1976; Thomas, 1977; Davis, 1977). Correlations reported between the WISC and WISC-R Performance IQ scores are .76 (Schwarting, 1975), .72 (Klinge et al., 1976), .82 (Weiner and Kaufman, 1976), .86 (Hamm et al., 1976), .84 (Brooks, 1977). Davis (1977) reported a correlation of .75 when the WISC-R was administered first and of .90 when the WISC was administered first. Schwarting (1975) found even lower subtest scaled score correlations for the two tests. For the Performance Scale, he found the correlations between the WISC and WISC-R subtests to be as follows:

Coding	.48
Picture Completion	.64
Picture Arrangement	.50
Block Design	.74
Object Assembly	.55

Mean subtest scaled scores have also been found to differ on the WISC and WISC-R. Schwarting (1976) found nine of the ten subtest means to be lower on the WISC-R; the difference between the mean subtest scaled scores for the Coding and Block Design subtests were significant beyond the .0005 level, with higher scores occurring on the WISC. Thomas (1977) found significantly lower scaled scores on the WISC-R for the Picture Completion, Block Design, Coding, Similarities, and Vocabulary subtests. The mean WISC-R subtest scores for Picture Arrangement, Object Assembly, Arithmetic and Comprehension were equal to or greater than the mean WISC subtest scores.

The above studies question the comparability of WISC and WISC-R test scores. Fluctuations on test scores due to the testing instrument and measurement need to be recognized and taken into account in test interpretation and educational planning.

Summary

The Wechsler Intelligence tests are reported to be the most frequently used tests of intelligence with deaf as well

as hearing individuals. This chapter presented a review of the literature which focused on studies investigating sex differences in the performance of hearing and deaf children on the Performance Scales of the Wechsler tests. Studies also indicated sex differences in the performance of hearing adults on the WAIS; these studies suggest that sex differences in intellectual functioning that begin in childhood may continue throughout life. Sex differences in the performance of deaf individuals on the WISC-R Performance Scale have also been reported; studies in this area indicated the need for further investigation of sex differences in the cognitive functioning of deaf individuals. Significant differences between the WISC and WISC-R have also been found and this should be taken into account in test interpretation for the deaf and hearing subjects.

CHAPTER III

DESIGN OF THE STUDY

This chapter provides an overview of the design of the research study. Included in this overview are a description of the sample and population characteristics, a review of the testing instrument used, a discussion of data collection procedures, and the presentation of the research hypotheses and the statistical analysis procedures.

Population

Data collected during the development of deaf norms on the WISC-R Performance Scale (Anderson and Sisco, 1977) provided the basis for the analysis. The normative sample consisted of 1,228 children attending residential and day schools for the deaf, located throughout the United States (see Appendix 4). Of the 1,228 subjects, the WISC-R data for 669 deaf males and 536 deaf females were used in the present study; the remaining 23 subjects were deleted due to missing or incomplete data. The deaf normative sample was large and well balanced with respect to the background variables controlled by Wechsler (1974) in the WISC-R standardization, namely sex, race, region, residence, and parental occupation. All subjects were congenitally or prelingually deaf and had a hearing loss of 70 dB or greater

(pure tone average) in their better ear. Subjects ranged in age from 6-0-0 to 16-11-30. Tables 1 and 2 present the characteristics of the deaf sample for comparison with the WISC-R hearing standardization sample (Wechsler, 1974).

Table 1

Characteristics of Deaf WISC-R Sample and Wechsler's WISC-R Sample

	Deaf WISC-R N = 1228	WISC-R[1] N = 2200
Sex		
Male	56.0%	50.0%
Female	44.0%	50.0%
Race		
White	78.1%	85.0%
Non-White	20.8%	15.0%
Unreported	1.1%	
Urban/Rural Residence		
Rural	16.4%	29.2%
Urban	82.5%	70.8%
Unreported	1.1%	
Geographic Region		
Northeast	19.9%	21.8%
North Central	33.8%	29.1%
South	20.2%	31.6%
West	24.8%	17.5%
Unreported	1.3%	
Parental Occupation		
Professional and Technical Workers	14.5%	15.0%
Managers, Officials, Proprietors, Clerical Workers and Sales Workers	18.9%	27.0%
Craftsmen and Foremen	16.7%	22.6%
Operatives, Service Workers (including private household), Farmers, and Farm Managers	29.3%	29.0%
Laborers, and Farm Foremen	12.4%	6.4%
Others[2]	8.2%	

[1]These data were obtained from the WISC-R manual (Wechsler, 1974).

[2]There were 101 deaf students whose parental occupation was listed as unemployed, on welfare, deceased, etc.

Table 2

Age Distribution of Samples

Age Group[1]	Number of Deaf Subjects[2]	Number of Hearing Subjects
6.5	53	200
7.5	69	200
8.5	84	200
9.5	79	200
10.5	196	200
11.5	181	200
12.5	125	200
13.5	113	200
14.5	129	200
15.5	121	200
16.5	73	200

[1]Age groups of deaf subjects ranged across the entire calendar year. For example, the 53 subjects listed at age 6.5 ranged in age from 6-0-0 to 6-11-30. Each subject in Wechsler's sample was tested within 6 weeks of his midyear.

[2]Ages for five students were not reported

The frequencies and percentages reported are fairly consistent with the 1970 National Census Report and with Wechsler's WISC-R standardization sample. Where differences occur, they are usually characteristic of this special population. For example, Rawlings (1973) reports a higher proportion of males than females among school age deaf children, and Ries, Bateman and Schildroth (1975) report higher rates of deafness among blacks than among whites in special education

programs throughout the United States. The deaf normative sample is, therefore, considered to be representative of deaf children attending deaf and day schools throughout the United States.

Instrumentation

The Performance Scale of the WISC-R was the instrument used to assess the mental abilities of deaf children participating in the standardization of the WISC-R, Performance Scale for deaf children by Anderson and Sisco (1977). The WISC-R is a revision of the WISC (Wechsler, 1949) which was, in turn, developed as a downward extension of the Wechsler-Bellevue Intelligence Test. For an in-depth discussion of the WISC and WISC-R see Wechsler (1949), Wechsler (1974), Sattler (1974), Anastasia (1968).

The WISC-R has five performance subtests from which a Performance IQ score can be derived, namely, Picture Completion, Picture Arrangement, Block Design, Object Assembly, and Coding. The Mazes is a supplementary test that can be substituted for one of the primary tests when necessary or appropriate (Wechsler, 1974). A brief description of the performance subtests and what they measure are presented below; differences between the WISC and WISC-R are noted.

Picture Completion

The Picture Completion subtest measures the ability to note pertinent missing details in pictures. Sattler (1974) states, "Picture Completion is a test of the ability to differentiate essential from nonessential details and requires

concentration, reasoning (or visual alertness), and visual organization and visual memory" (p. 182). The subtest also requires knowledge of objects and their parts, exposure and experience, good visual memory, and good functional visual skills. The Picture Completion subtest is considered to be a poor measure of "g"; it has been found to load heavily on Verbal Comprehension and Perceptual Organization factors (Cohen, 1959; Sattler, 1974).

The test consists of 26 drawings on separate cards. Each card depicts an object, scene or figure with an essential characteristic of the picture missing. The subject's task is to discover what is missing in each picture within a time limit (20 seconds) to earn points.

The WISC-R has 26 drawings as compared with 20 on the WISC; 14 cards are carry-overs from the WISC and one card has been modified. The WISC-R cards have been updated and are more contemporary; they also depict more black and more female subjects. As with the WISC, the WISC-R is to be discontinued after four consecutive failures.

Picture Arrangement

The Picture Arrangement subtest is a non-verbal reasoning test that assess the subject's ability to place pictures sequentially in a causal relationship. It requires the subject to interpret social situations and make social

judgements. It also measures social awareness, practical judgement, perception of part-to-whole of logical sequencing, social experience and the ability to plan and organize work. Sattler (1974) indicated it can be viewed as a measure of planning ability...an ability to comprehend and size up the total situation. It is usually considered to be the best single measure of "g" among the performance subtests (Cohen, 1959; Sattler, 1974).

The Picture Arrangement subtest consists of a series of pictures on cards that must be arranged by the examinee in the correct order to make a sensible story. There are 12 items on the subtest; the first four items (A through D) are given to children below the age of eight or to older children who are suspected of being mentally retarded. All items are timed with items 1 through 7 receiving credit for speed.

The WISC-R has 12 items as compared with 11 items on the WISC; three items were redrawn and carried over from the WISC, four items were considerably modified to reduce ambiguities in the story, and five items are completely new and not found on the WISC. New and revised items were included to update the test and to depict more people of both sexes and different races. Both the WISC and WISC-R have a demonstration card series; on the WISC-R, the sample item is entitled "Scale" which was Item D on the WISC. The WISC is discontinued after two consecutive failures; the WISC-R is

discontinued after three consecutive failures. The time limits for scoring the two tests also differ.

Block Design

The Block Design subtest measures the ability to perceive, analyze, synthesize and reproduce abstract designs with colored blocks. It is considered to be a non-verbal test of abstract reasoning ability and requires visual-motor coordination, whole-to-part perception, spatial visualization and perceptual organization abilities. Sattler (1974) considers it to measure speeded perceptual organization or spatial visualization ability. This subtest is considered to be a useful measure of "g" and Cohen's Perceptual Organization factor (Cohen, 1959; Sattler, 1974).

On the Block Design subtest, the subject is presented with a series of plastic blocks, colored on various sides, from which he is to construct a design similar to one made by the examiner or similar to a picture presented to the subject.

The WISC-R has 11 designs; two of the 11 are new, 9 are carried over from the WISC. WISC-R blocks have only two colors--red and white--while the WISC blocks are multi-colored. Time limits for completing designs requiring nine blocks were reduced from 150 seconds on the WISC to 120 seconds on the WISC-R, with bonus points allocated for quick, perfect performance.

Object Assembly

The Object Assembly subtest measures the ability to perceive and construct from part-to-whole familiar objects presented in puzzle form. It requires the ability to organize and synthesize concrete parts into meaningful wholes; it also requires good visual acuity and good visual-motor coordination. The Object Assembly subtest is considered to be a poor measure of "g" but a useful measure of Perceptual Organization (Cohen, 1959; Sattler, 1974).

The WISC and WISC-R both contain four items on this subtest which are basically jigsaw puzzles. The subject's task is to put the pieces of the puzzles together as quickly as possible. No demonstration or assistance on items is provided on the WISC. On the WISC-R, the examiner demonstrates a sample item to the subject and will demonstrate the correct assembly for item one if the subject does not successfully complete the item, independently. The Face and Horse items are on both the WISC and WISC-R. The Automobile item was redrawn on the WISC-R to reflect more contemporary vehicle styling. The five-piece mannequin item on the WISC was replaced by a seven-piece girl item. Time limits for completing the Car and Horse items were reduced from 180 seconds on the WISC to 150 seconds on the WISC-R. Rules for allotting bonus points for rapid, perfect performance were modified based on data from the new standardization sample.

Coding

The Coding subtest measures the ability to copy non-meaningful symbols for familiar digits. It requires eye-hand control, short-term visual memory, visual perception for directionality of symbols, good fixation ability in keeping one's place while working and an understanding of the code. According to Sattler (1974), success on this subtest depends upon the subject's skill with paper-and-pencil tasks as well as the subject's visual activity, motor activity, coordination and comprehension of the task. The Coding subtest is considered to be relatively low in "g" and loads exclusively on the Quasi-Specific factor (Cohen, 1959; Sattler, 1974).

The Coding subtest consists of two parts. Coding A, which is administered to children under eight years of age, and Coding B, which is administered to children eight years of age and older. Each part uses a sample.

> In Coding A, the sample consists of five shapes (star, circle, triangle, cross, and square). Within each shape, a special mark appears (vertical line, two horizontal lines, horizontal line, circle, and two vertical lines, respectively). The child is required to place within each shape the mark that appears in the sample. Five practice shapes are presented, followed by 43 shapes in the subtest.
>
> In Coding B, the sample consists of boxes containing the numbers 1 through 9, and a symbol below each number. The child is required to write the symbols shown in the sample in boxes that contain a number in the upper part and an empty space in the lower part. There are seven practice boxes, followed by 93 boxes in the subtest proper. The time limit for both Coding tasks is 120 seconds. (Sattler, 1974, p. 187)

The Coding subtests for the WISC and WISC-R are the same. They contain the same symbols and numbers and have the same scoring system and time limits. All the original WISC items were retained and none were modified or added. The only difference in the two tests is that the WISC-R Coding subtest is printed in a vivid red and blue contrast in the text booklet, while the WISC is printed in black and white. The WISC-R Coding subtest also requires that the subject use a red lead pencil; no such requirement was provided on the WISC.

Mazes

Many test developers and examiners believe the Mazes subtest taps too many skills and is non-delineating. It is generally considered to measure planning ability and perceptual organization. Visual-motor control, accuracy and speed are needed for success. It is considered to be relatively low in "g."

The Mazes subtest is a supplementary test consisting of nine mazes; the first two are administered to children under eight years of age or to subjects suspected of being mentally retarded. All items are timed, ranging from 30 to 120 seconds. The eight items of the WISC were retained on the WISC-R and one item was added. On the WISC-R, the subtest is printed in red and blue in a separate test booklet, while the WISC Mazes are printed in black and white. The scoring of errors on the WISC-R is considered to be more lenient than on the WISC.

Data Collection Procedures

To obtain the data needed for the Standardization of the WISC-R, Performance Scale for the Deaf (Anderson and Sisco, 1977), 22 nationally recognized schools for the deaf were selected and their assistance with the project requested by the researchers and by William J. McClure, President of the Florida School for the Deaf and the Blind. A cover letter (Appendix 1), a prospectus of the project (Appendix 2), and a questionnaire form (Appendix 3) were sent to the selected schools. Twenty of the twenty-two schools agreed to participate. Later, two southern schools dropped out of the project due to staff changes and this resulted in a less representative sample from the southern region than had been anticipated. Schools who participated in the project, as well as the psychologist who did the testing, are listed in Appendix 4. Testing was done by local qualified psychologists, experienced in testing the deaf; based upon the researcher's previous work experience with the deaf, it was felt that the use of such psychologists would greatly improve the validity and reliability of test results and subsequently the standardization data.

Data collection began in December, 1974, and was completed in June, 1976. All subjects were randomly selected and a total of 1,228 WISC-R protocols were received, each

complete with the WISC-R Record Form and Background Questionnaire (Appendix 5).

Research Hypotheses

This study tested the following research hypotheses:

Ho_1 There will be no significant difference between the overall deaf male mean WISC-R Performance Scale IQ score and the overall deaf female mean WISC-R Performance Scale IQ score.

Ho_2 There will be no significant difference between the overall deaf males mean WISC-R Performance IQ score and Wechsler's mean WISC-R Performance IQ score for males in the standardization sample ($\bar{X} = 100$).

Ho_3 There will be no significant difference between the overall deaf females mean WISC-R Performance IQ score and Wechsler's mean WISC-R Performance IQ score for females in the standardization sample ($\bar{X} = 100$).

Ho_4 There will be no significant difference between deaf males and deaf females subtest mean scaled scores on the WISC-R Performance subtests.

Ho_5 The main effect for sex for deaf children will not be significant for the five WISC-R Performance subtests.

Ho_6 The main effect for age will not be significant for the five WISC-R Performance subtests for deaf children.

Ho_7 There will be no significant interaction effect between sex and age for deaf children on the five WISC-R Performance Scale subtests.

Ho_8 There will be no significant differences in the factors of intelligence for deaf males and deaf females as measured by the WISC-R Performance Scale.

Ho_9 There will be no significant sex differences for deaf children in the correlational patterns between the WISC-R Performance Scale IQ scores and the WISC-R Performance subtest mean scale scores.

Statistical Analysis

Statistical Analysis System (SAS) 79.5 at the Northeast Regional Data Center at the University of Florida, Gainesville, Florida, was used to perform all data analyses. The assistance of the staff, and particularly the aid of John Dixon, at the Northeast Regional Data Center was most helpful and greatly appreciated. Differences between mean Performance IQ's and mean Performance subtest scores were measured by t-tests of significance between means.

A two-way factorial design (ANOVA) was used to test the significance of the sex, age and interaction (sex X age) effects.

Data were subjected to analyses using weighted and unweighted cell means in the calculation of marginal means. Analyses based on weighted cell means were considered to provide the appropriate statistics. Within the deaf population there are differences in the frequencies of deaf males and deaf females at various age levels, with a higher proportion of deaf males occurring at most age levels (Rawlings, 1973; Vernon, 1974; Ries, Bateman and Schildroth, 1975). In the present study there were an unequal number of deaf male and deaf female subjects in the various age groupings; statistics based upon the use of weighted cell means in the calculation of marginal means would therefore be more appropriate and more accurately reflect what would be expected to occur within the deaf population. Calculations based on weighted and unweighted cell means are reported in Chapter IV which reports the findings of the study.

The principal axis method of factor analysis was used to assess the factors of intelligence for deaf males and deaf females on the WISC-R Performance Scale. Pearson Product Moment Coefficient of Correlation was used to study the intercorrelation of subtests for both sexes and the correlational patterns between the WISC-R Performance Scale IQ scores and the WISC-R performance subtest mean scaled scores. Fisher's z was used to test the significance of difference between correlations. All hypotheses were tested at or beyond the .05 level of significance.

CHAPTER IV

RESULTS

This chapter presents the results of the study with respect to the research hypotheses. Statistical Analysis System (SAS) 79.5 at the Northeast Regional Data Center at the University of Florida in Gainesville, Florida, was used to perform all analyses. Analysis of the data was performed with the assistance of the staff, and particularly John Dixon, at the Northeast Regional Data Center. All hypotheses were tested at or beyond the .05 level of significance.

Hypotheses

Hypothesis One

There will be no significant difference between the overall deaf male mean WISC-R Performance Scale IQ score and the overall deaf female mean WISC-R Performance Scale IQ score.

The results support hypothesis one. There was no significant difference (.05 level) in the overall deaf male's mean Performance IQ score (97.23) and the overall deaf female's mean Performance IQ score (95.90). The "t" value for the difference between the means of the two groups was -1.45, favoring males, which was not significant at the .05 level (see Table 3).

Hypothesis Two

There will be no significant difference between the overall deaf males mean WISC-R Performance IQ score and Wechsler's mean WISC-R Performance IQ scores for males in the standardization sample ($\overline{X}$ = 100).

The results do not support hypothesis two. A significant difference (.05 level) was found between the overall deaf males mean WISC-R Performance IQ score (97.23) and Wechsler's mean WISC-R Performance IQ score for hearing males (100) in the standardization sample. The "t" value for the difference between the means of the two groups was -2.51, favoring hearing males, which was significant at the .05 level (see Table 3).

Hypothesis Three

There will be no significant difference between the overall deaf females mean WISC-R Performance IQ score and Wechsler's mean WISC-R Performance IQ score for females in the standardization sample ($\overline{X}$ = 100).

The results do not support hypothesis three and the null hypothesis was rejected. A significant difference (beyond the .01 level) was found between the overall mean WISC-R Performance IQ score for deaf females (95.90) and Wechsler's mean Performance IQ score for hearing females (100) in the standardization sample. The "t" value for the difference between the means of the two groups was -3.48, favoring hearing females in Wechsler's sample, which was significant

beyond the .01 level. Table 3 summarizes the findings for hypotheses one, two and three.

Table 3

T-tests of Mean WISC-R Performance Scale IQ's for Deaf Males and Deaf Females Compared with Deaf and Hearing Data

Sex	Hearing Status	N	Mean IQ	Standard Deviation	t
Female	Deaf	536	95.90	16.12	-1.45 N.S.
Male	Deaf	669	97.23	15.71	
Female	Deaf	536	95.90	16.12	-3.48**
Female	Hearing (Wechsler, 1974)	1100	100.00	15.00	
Male	Deaf	669	97.23	15.71	-2.51*
Male	Hearing (Wechsler, 1974)	1100	100.00	15.00	

*Significant at the .05 level.

**Significant beyond the .01 level.

N.S. - Not significant

Hypothesis Four

There will be no significant difference between deaf males and deaf females subtest mean scaled scores on the WISC-R Performance subtests.

Hypothesis four was rejected. Significant sex differences (beyond the .01 level) were found between subtest mean scaled scores on four of the five performance subtests. Significant differences, favoring males, were found for the Picture Completion, Block Design and Object Assembly subtests. The greatest significant difference, favoring females, was on the Coding subtest. No significant difference between deaf males and deaf females was found on the Picture Arrangement subtest. The results of "t" tests of the significance of difference between the means of the two sexes on the five performance subtests are presented in Table 4.

Table 4

T-tests of Subtest Mean Scaled Score Differences of Deaf Males and Deaf Females on the WISC-R, Performance Scale

Subtests	Scaled Score Means		t
	Males	Females	
Picture Completion	9.75	9.12	-3.70*
Picture Arrangement	9.61	9.45	- .91 N.S.
Block Design	9.72	9.18	-2.98*
Object Assembly	9.96	9.19	-4.40*
Coding	9.20	10.31	+6.54*

*Significant beyond the .01 level
N.S. - Not significant at the .05 level.

Hypothesis Five

The main effect for sex for deaf children will not be significant for the five WISC-R Performance subtests.

The results do not support hypothesis five when weighted cell means were used in the analysis of variance. Significant differences (beyond the .01 level) were found between deaf males and deaf females on four of the five performance subtests. Deaf males scored significantly higher (beyond the .01 level) on the Picture Completion, Block Design, and Object Assembly subtests; deaf females scored significantly higher (beyond the .01 level) on the Coding subtest. No significant difference between the sexes was found on the Picture Arrangement subtest. These findings are consistent with the results of "t" tests of difference between mean subtest scaled scores presented in Table 4.

No significant differences were found between the sexes on the five performance subtests when unweighted cell means were used in the analysis. The results of F-tests of the sex variable for deaf males and deaf females using weighted and unweighted cell means are presented in Table 5.

Scatterplots depicting the mean scaled scores by age grouping for deaf males and deaf females on the five performance subtests are presented in Appendices (7 through 11). The scatterplots provide pictorial support for findings based on the weighted cell means analysis. From the scatterplots

Table 5

F-tests of the Sex Variable for Deaf Males and Deaf Females on the WISC-R Performance Subtests

Subtest	Weighted Cell Means F	PR > F	Unweighted Cell Means F	PR > F
Picture Completion	13.85	.0002*	2.24	.1347 N.S.
Picture Arrangement	.84	.3610 N.S.	1.91	.1673 N.S.
Block Design	8.78	.0031*	.01	.9436 N.S.
Object Assembly	19.17	.0001*	2.66	.1032 N.S.
Coding	43.34	.0001*	.60	.4386 N.S.

*Significant beyond .01 level.

N.S. - Not significant.

it can be seen that, at most age groupings, males have higher subtest mean scaled scores than females on the Picture Completion, Block Design and Object Assembly subtests; at almost all age groupings, females have higher subtest mean scaled scores than males on the Coding subtest; and that there is considerable fluctuation and variation at all age groups in subtest mean scaled scores for the sexes on the Picture Arrangement subtest with neither sex displaying superiority.

Hypothesis Six

The main effect for age will not be significant for the five WISC-R Performance subtests for deaf children.

The results do not support hypothesis six. Using weighted and unweighted cell means in the analyses, a significant age effect, favoring males, was found on the Block Design subtest; no significant age effects were found on the Picture Completion, Picture Arrangement, Object Assembly, and Coding subtests. The t-test of the significance of difference between the overall mean scaled score for the two sexes on the Block Design subtest was also found to be significant at the .003 level, favoring males (Table 5). The results of the F-tests of the age variable for the two sexes using weighted and unweighted cell means in the analyses are presented in Table 6.

The scatterplot (Appendix 9) depicting the mean scaled scores by age groupings for deaf males and deaf females on the Block Design subtest, shows for both sexes a gradual decline with increasing age in mean scaled scores on the Block

Table 6

F-tests of the Age Variable for Deaf Males and Deaf Females on the WISC-R Performance Subtests

Subtest	Weighted Cell Means		Unweighted Cell Means	
	F	PR > F	F	PR > F
Picture Completion	2.08	.1497 N.S.	3.00	.0833 N.S.
Picture Arrangement	1.49	.2225 N.S.	1.99	.1586 N.S.
Block Design	5.15	.0235*	5.71	.0170*
Object Assembly	.00	.9637 N.S.	.00	.9685 N.S.
Coding	.43	.5104 N.S.	.22	.6405 N.S.

* Significant beyond the .05 level.

N.S. - Not significant.

Design subtest; females show the greatest decline in scores. It can also be seen that deaf males score higher than deaf females at most age levels on the Block Design subtest.

Hypothesis Seven

There will be no significant interaction effect for sex and age for deaf children on the five WISC-R Performance Scale subtests.

The results do not support hypothesis seven. When weighted and unweighted cell means were used in the analyses, a significant interaction effect (beyond the .01 level) was found on the Picture Completion subtest; no significant interaction effects were found for the Picture Arrangement, Block Design, Object Assembly, or Coding subtests. [A t-test of the significance of difference between the overall mean scaled score for the two sexes on the Picture Completion subtest was also significant beyond the .01 level, favoring males (Table 5).] The interaction effect approached significance on the Picture Arrangement ($F = 3.27$, $PR > F = .0709$) and the Coding ($F = 2.98$, $PR > F = .0848$) subtests when weighted and unweighted cell means were used in the analyses. Table 7 presents the results of F-tests for the interaction effect for the two sexes using weighted and unweighted cell means.

The scatterplot (Appendix 7) depicting the mean scaled scores by age groupings for males and females on the Picture

Table 7

F-tests of the Interaction Effect (Sex X Age) for Deaf Males and Deaf Females on the WISC-R Performance Subtests

Subtest	Weighted Cell Means		Unweighted Cell Means	
	F	PR>F	F	PR>F
Picture Completion	9.09	.0026*	9.09	.0026*
Picture Arrangement	3.27	.0709 N.S.	3.27	.0709 N.S.
Block Design	1.38	.2410 N.S.	1.38	.2410 N.S.
Object Assembly	.00	.9579 N.S.	.00	.9579 N.S.
Coding	2.98	.0848 N.S.	2.98	.0848 N.S.

*Significant beyond the .01 level.

N.S. - Not significant.

Completion subtest show considerable variability in the scores of both sexes on this subtest before age ten; males tend to show less variability than females. Between the ages of ten and eleven, the scores for males and females converge near the scaled score of 10, the mean for the general population; after age eleven, deaf males tended to score higher than deaf females at most age groupings.

Hypothesis Eight

There will be no significant differences in the factors of intelligence for deaf males and deaf females as measured by the WISC-R Performance Scale.

The results support hypothesis eight. There were no significant differences in the factors of intelligence for deaf males and deaf females. Using the principal axis method of factor analysis to analyze the data, only one factor--Performance Ability--emerged for both males and females and the factor loadings were almost identical for both sexes. The communality estimates (the proportion of variance explained by the factor) were also very similar for males and females on all subtests. The results are presented in Tables 8 and 9, respectively. From Table 8 it can be seen that the Coding subtest does not load as heavily with the Performance Factor as the other subtests.

Table 8

Factor Loadings on the WISC-R
Performance Subtests for
Deaf Females and Deaf Males

Subtests	Factor Loadings	
	Female	Male
Picture Completion	.71	.66
Picture Arrangement	.73	.72
Block Design	.75	.78
Object Assembly	.79	.74
Coding	.58	.58

Table 9

Communality Estimates on the WISC-R
Performance Scale
for Deaf Females and Deaf Males

Subtests	Communality Estimates	
	Female	Male
Picture Completion	.50	.44
Picture Arrangement	.53	.52
Block Design	.56	.60
Object Assembly	.62	.55
Coding	.34	.34

Hypothesis Nine

There will be no significant sex differences for deaf children in the correlational pattern of the mean WISC-R Performance subtest scores with the Performance IQ scores.

The results support hypothesis nine. No significant sex differences were found in the subtest correlations with the PIQ scores for the deaf sample. The results of t-tests of the significance of difference between the subtest correlations with the PIQ score for deaf males and deaf females are presented in Table 10. From Table 10 it can be seen that the subtest correlations are almost identical for the two sexes.

The average intercorrelation of subtests with each other for both sexes were also almost identical. These results are presented in Table 11.

Significant differences were found, however, when deaf male and deaf females subtest correlations with PIQ scores were compared with Wechsler's (1974, p. 47) correlations for the hearing standardization sample. Table 12 presents the results of t-tests of the significance of difference between the subtest correlations for the two groups. From Table 12 it can be seen that deaf females subtest scores correlated significantly higher with their PIQ scores than Wechsler's hearing sample on all subtests except Block Design; for deaf males, only the Picture Arrangement and Coding subtests had significantly higher correlations (beyond .01 level)

Table 10

T-tests of WISC-R Subtest Correlations with Performance IQ Scores for Deaf Males and Deaf Females

Subtests	Deaf Females (N = 532) r	Deaf Males (N = 656) r	t_a
Picture Completion	.77	.74	1.20 N.S.
Picture Arrangement	.79	.78	0.44 N.S.
Block Design	.79	.82	1.71 N.S.
Object Assembly	.81	.79	0.96 N.S.
Coding	.70	.69	0.32 N.S.

N.S. - Not significant.

t_a - To test differences in correlations Fisher's z was used:

$$t = \frac{z_1 - z_2}{\sqrt{\frac{1}{N_1-3} + \frac{1}{N_2-3}}}$$

Table 11

Intercorrelations of WISC-R Performance Subtests for Deaf Males and Deaf Females Ages 6-0-0 Through 16-11-30

	PC	PA	BD	OA	Coding
PC	-	.53(F) .51(M)	.53(F) .52(M)	.55(F) .48(M)	.42(F) .35(M)
PA		-	.50(F) .51(M)	.55(F) .51(M)	.51(F) .48(M)
BD			-	.67(F) .62(M)	.40(F) .44(M)
OA				-	.42(F) .42(M)
Coding					-

Table 12

T-tests of WISC-R Subtest Correlations With Performance IQ Scores for Deaf and Hearing Children

Subtests	Wechsler's[A] Sample N = 2200	Deaf Females N = 532		Deaf Males N = 656	
	r	r	t_a	r	t_a
Picture Completion	.72	.77	2.37*	.74	.96 N.S.
Picture Arrangement	.71	.79	3.89**	.78	3.54**
Block Design	.82	.79	1.82 N.S.	.82	.0 N.S.
Object Assembly	.77	.81	2.26*	.79	1.14 N.S.
Coding	.56	.70	4.94**	.69	4.81**

[A] = Wechsler, 1974, Table 15, p. 47.

* = Significant at .05 level.

** = Significant at .01 level.

N.S. = Not significant.

t_a = To test the difference in correlation Fisher's z was used:

$$t = \frac{z_1 - z_2}{\sqrt{\frac{1}{N_1-3} + \frac{1}{N_2-3}}}$$

with PIQ scores than Wechsler's standardization sample. There were no significant differences in the correlations of the Block Design subtest with PIQ scores for deaf males or deaf females when compared with the correlation for Wechsler's standardization sample. The Object Assembly subtest had the highest correlation with PIQ scores ($r = .81$) for the deaf females; the Block Design subtest had the highest correlation with PIQ scores ($r = .82$) for deaf males. The greatest statistically significant difference in correlations occurred on the Picture Arrangement and Coding subtests; deaf male and deaf female correlations on these subtests were significantly higher (beyond the .01 level) with their PIQ scores than hearing children. The greatest overall difference in correlations was on the Coding subtest. Wechsler's correlation for the standardization sample on the Coding subtest was $r = .56$, which was considerably below the correlations of the other performance subtests with the PIQ scores. The correlations of the Coding subtest with the PIQ score for deaf males and deaf females were .69 and .70, respectively, which was similar to their correlations for the other performance subtests.

Summary

This chapter presented the results of the study with respect to the research hypotheses. Six of the nine hypotheses

were rejected. No significant sex differences were found in the overall Performance IQ scores of deaf males and deaf females on the WISC-R, Performance Scale; there were also no significant sex differences in the factors of intelligence or in the correlational patterns of the mean WISC-R performance subtest scores with Performance IQ scores. For deaf males and females only one factor emerged, Performance Ability. Deaf Children's subtest scores correlated more highly with Performance IQ scores than did Wechsler's standardization sample.

Significant sex differences were found between the deaf sample and Wechsler's standardization sample in terms of overall Performance IQ scores and subtest mean scaled scores. Significant sex differences were found on the PC, BD and OA subtests, favoring males, and on the Coding subtest, favoring females; a significant age effect was found on the BD subtest and a significant interaction effect (sex X age) on the PC subtest. No significant sex, age or interaction effects were found on the PA subtest.

CHAPTER V

DISCUSSION OF RESULTS

This study was designed to evaluate sex differences in the performance of deaf children on the WISC-R Performance Scale by providing an in-depth analysis of the data collected by Anderson and Sisco (1977) during the standardization of the WISC-R, Performance Scale for deaf children. In was hypothesized that there would be no significant differences in the performance of deaf males and deaf females on the WISC-R, Performance Scale. Nine research hypotheses were set forth to test this thesis. Six of the nine hypotheses were rejected and the results indicated there are some significant sex differences in the performance of deaf children on the WISC-R, Performance Scale. From the study's results the following discussion is presented for each of the nine hypotheses.

Hypothesis One

There will be no significant difference between the overall deaf male mean WISC-R Performance Scale IQ score and the overall deaf females mean WISC-R Performance Scale IQ score.

The results of the study support hypothesis one in that no significant difference was found in the overall mean Performance IQ scores for deaf males and deaf females. This is consistent with the findings of Vonderhaar and Chambers (1975)

but not with that of Vonderhaar (1977). Vonderhaar and Chambers (1975) reported slight, but insignificant differences, favoring males, between the PIQ scores of deaf males and deaf females. Vonderhaar (1977) found deaf males obtained significantly higher PIQ scores than deaf females on the WISC and WISC-R. The findings of the present study lend considerable support to Vonderhaar and Chambers findings, particularly in view of the large and well balanced characteristics of the present sample; the sample consisted of 536 deaf females, 669 deaf males and was well balanced with respect to the background variables controlled by Wechsler (1974) in the WISC-R standardization sample. Vonderhaar's (1977) finding that deaf males obtained significantly higher PIQ scores than deaf females may reflect sample characteristics and not population characteristics. The present finding is also consistent with studies of hearing children which have reported no systematic difference in the overall IQ scores of males and females (Speck, 1978; Williams, 1975; Maccoby and Jacklin, 1974; Cattell, 1971; Maccoby, 1966). These results suggest that for deaf, as well as hearing individuals, there is no significant sex difference in overall intellectual ability, particularly as displayed on the Wechsler scales.

Hypothesis Two

There will be no significant difference between the overall deaf male mean WISC-R Performance IQ score and

Wechsler's mean WISC-R Performance IQ score for males in the standardization sample ($\bar{X}$ = 100).

The results of the present study do not support hypothesis two; the difference between the mean PIQ score for deaf males (97.23) and the mean PIQ score for the males in Wechsler's standardization sample (100) was significant at the .05 level. This finding is inconsistent with the findings of Vonderhaar and Chambers (1975) and Vonderhaar (1977), who found no significant difference in the mean PIQ scores of deaf males when compared with the mean PIQ scores of males in Wechsler's standardization sample. Deaf males in Vonderhaar's (1977) study received a mean PIQ score of 100.33, which is slightly above the mean of 100 for Wechsler's sample. The findings of the presenting study suggest that when a large, well balanced sample of deaf children is used in the analysis, a significant difference emerges in the overall PIQ scores of deaf males and hearing males such as those included in Wechsler's standardization sample.

Hypothesis Three

There will be no significant difference between the overall deaf females mean WISC-R Performance IQ score and Wechsler's mean WISC-R Performance IQ score for hearing females in the standardization sample ($\bar{X}$ = 100).

The results of the present study do not support hypothesis three; the difference between the mean PIQ score for deaf

females (95.90) and the mean PIQ scores for females in Wechsler's standardization sample (100) was significant beyond the .01 level. This finding is consistent with that of Vonderhaar (1977), who also found a significantly lower mean PIQ for deaf females (94.93) when compared with Wechsler's mean PIQ score for females in the standardization sample.

The findings related to hypotheses two and three above indicate there is a significant sex difference in the performance of deaf children on the WISC-R Performance Scale, when compared with the hearing children in Wechsler's standardization sample. Deaf males and deaf females scored significantly below males and females in Wechsler's sample, with females showing the greatest discrepancy.

Hypothesis Four

There will be no significant difference between deaf male and deaf female subtest mean scaled scores on the WISC-R Performance subtests.

Hypothesis four was rejected. Within the deaf sample, significant sex differences (beyond the .01 level) were found between mean subtest scaled scores on four of the five performance subtests. T-tests of the significance of difference between the mean subtest scaled scores for the two sexes found significantly higher scores for males on the Picture Completion, Block Design, and Object Assembly subtests and a significantly higher score for females on the Coding subtest. No significant

sex difference was found on the Picture Arrangement subtest. These findings were consistent with the results of analysis of variance of weighted cell means which also found a significant sex effect on the same performance subtests, in the expected direction. A significant interaction effect between sex and age was also found on the Picture Completion subtest; on this subtest the performance of deaf males and females varied with age and the superiority of either sex depended on the particular age level under consideration. Based on the results of this study, the following discussion is presented for each of the performance subtests.

Picture Completion (PC)

The results of this study found deaf males received significantly higher (beyond the .01 level) mean scaled scores than deaf females on the PC subtest. This finding is consistent with the findings of previous research studies using deaf and hearing subjects which have reported higher scores for males on the PC subtest. Vonderhaar and Chambers (1975) found deaf males scored higher than deaf females on the PC subtest but the difference between the two groups was not significant. Vonderhaar (1977) found deaf males scored higher than deaf females on the PC subtest of the WISC and WISC-R; the difference between the two groups on the WISC was significant at the .05 level. Within the hearing population, significantly higher scores for males on the PC subtest of the Wechsler Scales have been reported by Holowinsky and Pascale (1972), Silverstein and Fisher (1960), Wechsler (1958),

Miele (1958), and Goolishan and Foster (1954).

The above findings suggest that males generally perform better than females on the PC subtest. This may not be the case for deaf children. In the present study a significant interaction effect between sex and age was found on the PC subtest; the superiority of either sex on this subtest varied with age. The scatterplot for the PC subtest (Appendix 7) provides pictorial support for an interaction effect. It shows considerable variability in scores of both sexes before age ten, with males generally showing less variability than females. Between the ages of ten and eleven, the scores for both sexes tend to converge near the scaled score of 10, which is the mean scaled score for the PC subtest in Wechsler's standardization sample. After age eleven, deaf males tend to score higher than deaf females at most age levels. This suggests that, after age eleven, the abilities required by the PC subtest develop to a greater extent in deaf males than deaf females. Further research is needed to substantiate this finding. Research should also be directed toward identifying the specific cognitive skills required by this subtest and toward identifying the specific factors (genetic, cultural, educational, etc.) that contribute to the greater development of these skills in deaf males.

Picture Arrangement (PA)

The results of this study found no significant difference in the performance of deaf males and deaf females

on the PA subtest. A t-test of the significance of difference between the means for the sexes on the PA subtest was not significant at the .05 level and F-tests of the sex, age, and interaction (sex X age) effects were not significant at the .05 level. The scatterplot for the PA subtest (Appendix 8) also shows no consistent pattern or trend toward superiority for either sex. These findings are consistent with those of Karnes and Brown (1980) and Vance (1979) who found no significant difference in the performance of gifted and retarded males and females on the PA subtest. Within the deaf population, Vonderhaar and Chambers (1975) and Vonderhaar (1977) reported higher scores by deaf males on the WISC-R, PA subtest, but the difference between the sexes was not significant.

The scatterplot for the PA subtest (Appendix 8) shows that the majority of scores for both sexes, regardless of age, falls below a scaled score of 10, which is the mean scaled score on the PA subtest for Wechsler's standardization sample. This is consistent with expectations based on previous research findings which have reported the mean for deaf children on the PA subtest to be significantly below that of hearing children (Hirshoren, Hurley and Kavale, 1979; Hirshoren, Hurley and Hunt, 1977; Anderson and Sisco, 1977; Vonderhaar, 1977; Vonderhaar and Chambers, 1975; Hine, 1970). Vonderhaar and Chambers (1975) found that the PA subtest of the

WISC may be more difficult for deaf youngsters than the PA subtest of the WISC-R. In a comparative study of the WISC and WISC-R, they found both sexes scored higher on the WISC-R, PA subtest; the difference in performance on the PA subtests of the two tests was significant for females but not for males.

Research by Anderson and Sisco (1980) has suggested that the above findings may not hold true for deaf children of deaf parents. They found deaf children of deaf parents (dc/dp), regardless of sex, performed significantly better than deaf children of hearing parents (dc/hp) on all WISC-R, Performance subtests, including PA. Dc/dp displayed strengths and not weaknesses on this subtest and their mean scaled score on the PA subtest (11.1) was above that of hearing children in Wechsler's (1974) standardization sample (10). Their findings led them to conclude that dc/dp constitute a subgroup within the general deaf population; this subgroup has very different intellectual characteristics which must be taken into account in test interpretation and in educational, vocational and personal planning.

The scatterplot for the PA subtest (Appendix 8) also shows that that the mean scaled scores for both sexes decreased slightly with age. The F-test for the age effect was not significant but the F-test for the interaction effect (sex X age) for the PA subtest approached significance ($F = 3.27$; $PR > F = .07$). This finding suggests that further investigation of

the relationship between sex and age on the PA subtest would be desirable. An interaction effect may be masking or obscuring the main effects of sex or age.

In general, the present as well as previous research findings indicate that deaf children, regardless of sex, do poorly on the PA subtest. If the skills required by this subtest are important for academic and vocational tasks, then it appears to be important that the factors contributing to the poor performance by deaf children on this subtest be identified. The identification of these factors would make possible more appropriate educational and vocational programming and lead to the development of appropriate preventive or remedial procedures.

Block Design (BD)

The results of this study found deaf males scores significantly higher than deaf females on the BD subtest. A t-test of the difference between the overall means for the two groups was significant at the .01 level and a significant sex effect, favoring males, was found using ANOVA weighted cell means. The scatterplot for the BD subtest (Appendix 9) also shows that deaf males scored higher than deaf females at most age levels; deaf males generally scored in the average to high average range on this subtest, while females tended to score in the low average (or below) range. These findings are consistent with those of previous studies using deaf and

hearing subjects which have reported higher scores for males, when compared with females, on the BD subtest of the Wechsler scales (Karnes and Brown, 1980; Speck, 1978; Vonderhaar, 1977; Vonderhaar and Chambers, 1975; Holowinsky and Pascale, 1972; Silverstein and Fisher, 1960; Wechsler, 1958; Miele, 1958; and Goolishan and Foster, 1954).

A significant age effect was found for the BD subtest, using weighted and unweighted cell means. The scatterplot for the BD subtest provides additional support for an age effect. From the scatterplot it can be seen that there is a gradual decline in scores with increasing age for both sexes; females show the greatest decline in scores, particularly at older age levels.

Most studies have found no great discrepancies in the performance of deaf and hearing children on the BD subtest. The findings of the present study indicate that deaf males show considerable strength on the BD subtest when compared with deaf females. Further research is needed to identify the factors contributing to male superiority on this test. Research is also needed to determine how the strengths of deaf males in this area can be used to facilitate their academic and vocational achievement. The BD subtest is considered to be a good non-verbal test of abstract reasoning ability. The ability to think abstractly is considered important, if not essential, in all higher learning processes. The low academic and vocational achievement of most deaf youngsters suggests that

this potential is not being utilized adequately in their present educational and vocational programs.

Object Assembly (OA)

The results of this study found deaf males scored significantly higher than deaf females on the OA subtest. A t-test of the significance of difference between the overall means of the two sexes on the OA subtest was significant beyond the .01 level, favoring males; a significant sex effect, favoring males, was also found using analysis of variance of weighted cell means. From the scatterplot (Appendix 10) for the OA subtest it can be seen that deaf males have higher mean scaled scores than deaf females at most age groupings. Males generally score average or above average at most age levels, while females score in the average to below average range at most age levels.

The results of this study are consistent with the findings of Vonderhaar and Chambers (1975) and Vonderhaar (1977) which also found deaf males scored significantly higher than deaf females on the OA subtest. The deaf, as a group, have generally been found to display strength on the OA subtest. (Anderson and Sisco, 1977; Lavos, 1962; Goetzinger and Rousey, 1957; Levine, 1956; and Graham and Shapiro, 1953). During the standardization of the WISC-R for the deaf, Anderson and Sisco (1977) found deaf children, regardless of sex, received their highest scores on the OA subtest, with the mean subtest

score for the deaf ($\bar{X}$ = 10.32) being slightly higher than the mean for Wechsler's stnadardization sample ($\bar{X}$ = 10). The OA subtest was also found by Vonderhaar (1977) to be one of the most stable on the performance subtests with the deaf; BD was also found to be very stable while Coding and PC were found to be the most variable.

There has been little consistency in research findings regarding sex differences in the performance of hearing children on the OA subtest. Vance (1978) found retarded males scored higher than retarded females on the WISC-R but the mean score difference was not significant. He also found the greatest variation in the scores of retarded children of both sexes to be on the OA subtest. Miele (1958) reported that normal females scored significantly better than normal males on the WISC, OA subtest, after the age of seven. Using a sample of gifted children, Karnes and Brown (1980) found no significan difference in the performance of males and females on the OA subtest of the WISC-R. Wechsler (1974) provides no comparative data between the sexes in the WISC-R manual for the OA subtest.

The findings of the present study indicate there are significant differences in the performance of deaf males and deaf females on the WISC-R, OA subtest; there does not appear to be sufficient evidence to make any conclusions regarding sex differences in the performance of hearing children on this

subtest. Further research is needed to substantiate present findings and to clarify sex differences in performance on the OA subtest that might exist in the hearing population. Further research should also be directed toward identifying how the strengths of the deaf, as displayed on this subtest, could be better used to facilitate their educational and vocational achievement.

Coding

The greatest significant difference between the performance of deaf males and deaf females occurred on the Coding subtest. Deaf females scored significantly higher than deaf males on this subtest at most age levels. A t-test of the significance of difference between the two groups on this subtest was significant beyond the .01 level and a significant sex effect (at the .001 level, favoring females) was found using analysis of variance of weighted cell means. The scatterplot for the Coding subtest (Appendix 11) shows deaf females generally received mean scaled scores of 10 or above at most age levels while males generally received mean scaled scores below 10 at most age levels; a scaled score of 10 is the mean for Wechsler's standardization sample. These results are consistent with previous research findings with both deaf and hearing subjects which have consistently reported superior performances by females on the Coding subtest of the Wechsler scales, regardless of age or level of overall intelligence (Karnes and Brown, 1980: Vance, 1979; Speck, 1978;

Vance et al., 1978; Quereshi, 1968; Alper, 1967; Silverstein and Fisher, 1960; Wechsler, 1958; Miele, 1958; and Norman, 1953).

Related studies have provided information which may be helpful in understanding sex differences in performance on the Coding subtest. Bayley (1968), in a longitudinal study, found the Digit Symbol (Coding subtest on the WISC and WISC-R) to be the most stable subtest for females over a 16 to 36 year interval; it was also the identifying scale in an independent female factorial dimension. For females, the Digit Symbol subtest was independent of the mental abilities scales and independent of behavioral variables; this independence of the Digit Symbol subtest led Bayley to question whether or not, for females, the genetic determiners of intelligence are relatively strong in the type of mental processes required by the Coding/Digit Symbol subtests. In another study, Howe (1977) found that the Coding task may be perceived differently by males and females and this may partially account for the large discrepancy in performance of the sexes on the subtest. She found Coding loaded heavily on a Verbal factor for males and appeared to be perceived by males as a verbal symbolic task; for females Coding loaded heavily on a Perceptual-Performance factor suggesting that for females Coding is perceived more as a non-language, visual-perception task. She also found that the perception of Coding as a symbolic-language task, as opposed

to a non-language visual-perception task, may be age related as well as sex related. Some support for this position was found in the present research in that the interaction effect for sex X age on the Coding subtest approached significance ($PR > F = .085$).

The superior performance of deaf and hearing females on the Coding subtest suggests that the abilities measured by this test are present and develop to a greater extent in females than males. Further research is needed to identify the specific factors (genetic, environmental, educational, etc.) that contribute to females superiority on this subtest. There also needs to be further investigation of the relationship between performance on the Coding subtest and the achievement of academic skills. Research by Lyle and Johnson (1974) found writing speed and associate learning to be significant predictors of WISC Coding Performance; Johnson and Lyle (1972) and Johnson and Lyle (1973) also found significant sex differences, favoring females, in writing speed and associative learning tasks. Many of the skills required by the Coding subtest (such as eye-hand control, visual-memory, visual-perception for directionality, visual-fixation ability, etc.) are also necessary for the achievement of academic skills. A greater understanding of the factors contributing to successful performance on Coding should be useful in educational and vocational programming.

Hypothesis Five

The main effect for sex for deaf children will not be significant for the five WISC-R Performance subtests.

The findings of this study do not support hypothesis five. The results of ANOVA were consistent with the findings of t-tests of the difference between mean subtest scales scores; these findings revealed significant sex differences on four of the five performance subtests. Deaf males scored significantly higher than deaf females on the PC, BD, and OA subtests while deaf females scored significantly higher than deaf males on the Coding subtest. No significant difference between the sexes was found on the PA subtest. The scatterplots depicting the mean scaled scores by age groupings for deaf males and deaf females on the performance subtests provided pictorial support for the above findings. From the scatterplots it can be seen that deaf males have higher subtest mean scaled scores than deaf females at most age levels on the PC, BD, and OA subtests; deaf females have higher scores than deaf males at almost all age levels on the Coding subtest. These findings are generally consistent with previous research findings related to sex differences in performance on these subtests. A discussion of the research related to each of the performance subtests is presented with Hypothesis Four.

Hypothesis Six

The main effect for age will not be significant for the five WISC-R Performance subtests for deaf children.

The results of this study do not support hypothesis six. F-tests revealed a significant age effect for the BD subtest but not for the PC, PA, OA, and Coding subtests. Deaf males scored significantly higher than deaf females at most age levels on the BD subtest; with increasing age, both sexes showed a gradual decline in mean scaled scores. In general, females showed a greater decline in scores with age than deaf males. The scatterplot for the BD subtest (Appendix 9) provides pictorial support for the age effect. These findings do not agree with Vonderhaar's (1977) data which showed no consistent age trends for deaf children on any of the WISC or WISC-R performance subtests.

It appears that little research has been directed towards assessing age differences in subtest performance by deaf children. The absence of data indicates the need for further investigation in this area. Educational programming for deaf children should seek to provide them with the experiences necessary to achieve the expected developmental progress, intellectually and academically.

Hypothesis Seven

There will be no significant interaction effect for sex and age for deaf children on the five WISC-R Performance subtests.

The results do not support hypothesis seven. F-tests of the interaction effect for sex and age found a significant

interaction effect for the PC subtest but not for the PA, BD, OA, or Coding subtests. The interaction effect for the PA subtest approached significance ($F = 3.27$; $PR > F = .07$). The scatterplots for the PC and PA subtests provides pictorail support for these findings.

The above findings suggest that performance on the PC, and to a lesser extent on the PA, may be age and sex related. Further investigation of the interaction effect between sex and age on these subtests would be desirable to substantiate present findings. Awareness of the relationship between age and performance on these subtests would facilitate test interpretation and make possible more appropriate educational planning.

Hypothesis Eight

There will be no significant differences in the factors of intelligence for deaf males and deaf females as measured by the WISC-R, Performance Scale.

The results of this study support hypothesis eight in that no significant sex differences were found in the factors of intelligence for the deaf sample. Only one factor, Performance Ability, emerged for both deaf males and deaf females. The factor loadings and communality estimates were very similar for both sexes on all subtests (see Tables 8 and 9). These findings suggest that the Performance Scale of the WISC-R

may be a purer measure of non-verbal, performance abilities for deaf children, regardless of sex, than it is for hearing children. Factor analytic studies of the WISC and the WISC-R with hearing children have consistently identified the Wechsler Scales as measuring several factors of intelligence. Those factors most consistently identified include Verbal Comprehension, Perceptual Organization and Freedom from Distractibility (Cohen, 1959; Kaufman, 1975; Silverstein, 1977; Reynolds and Gutkin, 1980), as well as Verbal Factors, Perceptual-Evaluation Factors, Memory for Systems Factors, and a Specific Non-Verbal Factor (Speck, 1978). The WISC-R Performance Scale therefore, appears to measure several factors of intelligence in hearing children but primarily "Performance Ability" in deaf children.

A study by Ahren's (1978) provides some additional information which may be useful in understanding sex differences in the factors of intelligence and sex differences in the performance of deaf and hearing children on the performance subtests. Ahren's found hearing females showed earlier maturity in factorial structures beginning with "g" and that this earlier maturity of the females continued throughout the definition of other factors. She also found that, for hearing children, the structural components of intelligence as measured by the WISC-R varied by sex and age. Significant differences, favoring females, in visual-motor ability and

speed skills emerged at 9½ years of age and was clearly established by 11½ years of age. Significant differences favoring males in visual-motor planning ability were identified at almost all age levels. If Ahren's findings hold true for deaf as well as hearing children, they may partially account for the finding that females perform better than males on the Coding subtest and males perform equal to or better than females on the other performance subtests. The Coding subtest relies heavily on visual-motor and speed skills, which appear to develop earlier and to a greater extent in females, while the other performance subtests rely heavily on visual-motor planning ability, which appears to develop to a greater extent in males. Further research is needed to substantiate Ahren's findings and to clarify how subtest performance varies by sex and age. The specific factors (genetic, environmental, educational, etc.) that contribute to male or female superiority on a subtest also need to be identified. A greater understanding of these factors would help clarify sex differences in cognitive functioning and intellectual potential. Such information should facilitate educational and vocational planning.

Hypothesis Nine

There will be no significant sex differences for deaf children in the correlational patterns of the mean WISC-R Performance subtests scores and the Performance IQ scores.

The results support hypothesis nine. No significant sex differences were found for deaf children in the intercorrelations of the WISC-R subtests or in the correlations between the mean PIQ's and the mean subtest scaled scores. The correlational patterns were similar, almost identical, for deaf males and deaf females (see Tables 10 and 12).

Table 12 shows that the correlations of PIQ scores with subtests for the deaf sample were equal to or higher than the correlations for Wechsler's standardization sample on all subtests except Block Design; on the Block Design subtest the correlation score for deaf females ($r = .79$) was slightly below that of Wechsler's sample ($r = .82$). This finding indicates the performance subtests of the WISC-R are more consistent with the total PIQ pattern for the deaf than they are for the hearing in Wechsler's standardization sample. Table 12 also shows a significantly higher correlation of the Coding subtest with PIQ scores for deaf children than for hearing children; for deaf children there is no great discrepancy between the correlation of the Coding subtest and the correlations of the other subtests with the PIQ scores, as is the case for Wechsler's sample. This suggests that the Coding subtest provides a better measure of the performance abilities in deaf children than in hearing children. If this is the case, then short forms of the WISC-R, Performance Scale using the Coding subtest, should provide a more accurate estimate

of the intellectual abilities of deaf children than of hearing children.

Summary

This chapter presented a discussion of the results of the study with respect to the research hypotheses. The major findings related to each hypothesis were reviewed and discussed relative to other research findings regarding the performance of deaf and hearing children on the WISC-R, Performance Scale. The relevance of the present findings to educational and vocational planning for deaf children was indicated when appropriate.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

Sex differences in cognitive abilities have been reported for deaf as well as hearing children. The WISC-R is considered to be one of the most widely used tests of mental ability with deaf as well as hearing children. This study was designed to evaluate sex differences in the performance of deaf children on the WISC-R, Performance Scale by providing an in-depth analysis of the data collected by Anderson and Sisco (1977) during the standardization of the WISC-R, Performance Scale for deaf children. A total of 669 deaf males and 536 deaf females was included in the present study; the deaf sample was well balanced with respect to the background variables controlled by Wechsler (1974) in the WISC-R standardization sample, namely sex, race, region, residence, and parental occupation. Subjects ranged in age from 6-0-0 to 16-11-30. All subjects were congentially or prelingually deaf and had a hearing loss of 70 dB or greater (pure tone average) in their better ear.

It was hypothesized that there would be no significant sex differences in the performance of deaf children on the WISC-R, Performance Scale. Of the nine hypotheses set forth to test this thesis, six were rejected. Chapter IV presents

the results of the study and Chapter V provides an in-depth discussion of these results. The findings of the present study led to the following conclusions and recommendations:

Conclusions

1. Deaf females are similar to deaf males in terms of their overall, non-verbal, cognitive abilities. No significant sex differences were found in the overall mean PIQ scores of deaf males and deaf females on the WISC-R, Performance Scale. The Performance Scale of the WISC-R, therefore, appears to be free of sex bias and to provide a good objective measure of the non-verbal performance abilities of deaf as well as hearing children. Subtle, significant sex differences in subtest score patterns did occur and these sex differences must be taken into account in test interpretation; similar sex differences in subtest score patterns have also been reported for hearing children.

2. Deaf males and females differ from hearing males and females in terms of their overall non-verbal cognitive abilities. Males and females in the deaf sample received significantly lower mean PIQ scores than hearing males and females in Wechsler's standardization sample, with deaf females showing the greatest discrepancy. Overall analysis of the data, however, found more similarities than differences between deaf and hearing children in their performance

on subtests. Deaf children performed similar to hearing children on three of the five performance subtests, namely, Picture Completion, Block Design, and Object Assembly. The greatest discrepancy between the groups occurred on the Picture Arrangement and Coding subtests. Deaf children, regardless of sex, performed significantly below the children in Wechsler's standardization sample on the Picture Arrangement subtest; deaf males, but not deaf females, scored significantly below Wechsler's sample on the Coding subtest. Deaf females had no difficulty with Coding and their mean scaled score on this subtest was slightly above that for hearing children in Wechsler's standardization sample.

Previous data analysis by Sisco and Anderson (1980) found that deaf children of deaf parents (dc/dp) showed strengths and not weaknesses on Picture Arrangement and Coding and received significantly higher scores on these subtests than deaf children of hearing parents (dc/hp) or hearing children in Wechsler's standardization sample. Analysis of the data relative to the hearing status of the parents led Sisco and Anderson to conclude that dc/dp do not show the same developmental and/or cognitive deficits as dc/hp. As a subgroup within the deaf population, dc/dp display very different intellectual characteristics than dc/hp; further research needs to be directed towards clarifying the differences between these two subgroups. It is also likely that the educational and vocational needs of students in these two subgroups will vary and

programming must be individualized to assure optimal cognitive growth.

3. There are significant sex differences in the subtest score patterns of deaf children on the WISC-R, Performance Scale. Deaf males generally performed better than deaf females and received significantly higher mean scaled scores on three of the five performance subtests, namely, Block Design, Object Assembly, and Picture Completion. Deaf males also received a higher mean scaled score than deaf females on the Picture Arrangement subtest but the difference between the two groups was not significant at the .05 level. Deaf females' best overall performance was on the Coding subtest where they displayed considerable superiority over deaf males. These findings suggest that the non-verbal cognitive abilities of deaf males are less severely affected by their auditory impairment, and its ramifications, than are deaf females. Research needs to be directed towards clarifying the specific abilities required by subtests and towards identifying the differential effect of a severe auditory impairment upon the development of these abilities in males and females. Variations in subtest performance must also be taken into account in test interpretation.

4. Factors such as age and the interaction of sex and age can effect subtest performance. A significant age effect was found on the Block Design subtest and a significant interaction effect (sex X age) on the Picture Completion subtest.

Such factors affecting subtest performance must be taken into consideration in test interpretaton. Research should also be directed towards identifying additional factors that may influence the performance of deaf children on the WISC-R subtests and other tests of intelligence.

5. There are no significant differences in the factors of intelligence for deaf males and deaf females as displayed on the WISC-R, Performance Scale. Using the principal axis method of factor analysis to analyze the data, only one factor, Performance Ability, emerged for both deaf males and deaf females. Since more than one factor of intelligence has generally been reported for hearing children, it appears that the WISC-R, Performance Scale provides a purer measure of the non-verbal, cognitive abilities of deaf children, regardless of sex, than it does for hearing children. Additional studies in this area would be desirable to substantiate this finding.

6. For deaf children, there are no significant sex differences in the intercorrelations of the WISC-R performance subtests or in the correlation patterns of the performance subtests with PIQ scores. The correlation and intercorrelation patterns were similar, almost identical, for deaf males and deaf females. Furthermore, deaf children's performances on the WISC-R subtests, regardless of sex, were more consistent

with their total PIQ pattern than was the case for Wechsler's standardization sample. The correlation of the mean subtest scales scores with the PIQ scores for the deaf sample were equal to or higher (in most cases) than the correlations for Wechsler's sample. The significantly higher correlation of the Coding subtest with PIQ score for the deaf indicates that this subtest provides a better measure of the non-verbal performance abilities of deaf children (in this area) than it does for hearing children. These findings, in general, suggest that the Performance Scale of the WISC-R provides a better estimate of the non-verbal cognitive abilities of deaf youngsters than of hearing children.

Recommendations

1. This research found no significant sex bias in the WISC-R, Performance Scale when used with deaf children. As an assessment tool, it can be recommended for use with deaf, as well as hearing children, regardless of sex.

2. Significant sex differences were found in deaf children's subtest score patterns on the WISC-R, Performance Scale. These differences must be taken into account in test interpretation. It is recommended that further research be directed towards clarifying these differences and towards identifying additional factors that may influence subtest performance. Research should also be directed towards identifying appropriate remedial procedures and finding ways to

utilize the strengths of deaf youngsters (as displayed on subtests) more appropriately to facilitate their educational and vocational achievement.

3. The greatest overall sex difference for deaf children was found on the Coding subtest; the difference between the performance of males and females on this subtest was highly significant with females displaying considerable superiority over males at almost all age groupings. The superior performance of deaf, as well as hearing females on this subtest suggests that the abilities measured by this test are present to a greater extent in females than males. Bayley's (1968) study suggests a possible genetic basis for this difference, while Howe's (1977) study suggests that differences in performance are due to differences in perception of the Coding task; females tend to see the Coding task as a non-language, visual-perception task, while males see Coding more as a symbolic language task. Further research is recommended to clarify the specific factors leading to successful performance on this subtest. The strengths of females in this area should also be used more appropriately in educational and vocational planning to facilitate their achievement.

4. Dc/dp have been found to differ in their intellectual characteristics from dc/hp. Research should be directed towards clarifying sex differences in cognitive abilities of these two subgroups within the deaf population.

5. No significant sex differences were found in the factors of intelligence for deaf children. Further research in this area is recommended to substantiate this finding.

Summary

This chapter provided a brief summary of the nature and purpose of the present study as well as the conclusions and recommendations derived from the research. Significant sex differences were observed in the deaf sample; awareness of these differences is important for test interpretation and educational and vocational planning for deaf youngsters.

APPENDIX 1
LETTER TO SCHOOLS

The Florida School for the Deaf and the Blind

AM J. McCLURE
PRESIDENT

POST OFFICE BOX 1209
ST. AUGUSTINE, FLORIDA 32084
904-824-1554

December 2, 1974

Our Child Study Center feels that the new WISC-R is a much improved test for deaf children and, like its predecessor, is quite likely to be the most widely used test of mental ability with deaf children for some time to come. This new version would be much more effective if there were standardized norms for our specific population in schools for the deaf. Mrs. Frankie Sisco, a psychologist in our Child Study Center, together with Dr. Richard J. Anderson, of the Psychology Department at the University of Florida, is developing plans to establish norms for the WISC-R which have been standardized on a deaf population.

To aid in securing the data upon which norms can be standardized, we are asking 15 - 20 schools for the deaf with recognized professional stature if they would assist in this project. More complete information is contained in the enclosure. We hope that after studying it you will be willing to lend your assistance.

Please let us hear from you.

Sincerely,

William J. McClure
President

WJM:a

Enclosures

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APPENDIX 2
PROSPECTUS OF PROJECT

November 25, 1974

TO: The Administrators and Psychological Staffs of Selected Institutes for the Deaf

FROM: The Florida School for the Deaf and the Blind in Cooperation with the Department of Psychology, University of Florida

RE: Project to Re-standardize the WISC-R for the Deaf

In continuing attempts to provide better and more effective services to the deaf child, improved psychological evaluation and more appropriate personal and educational planning based on psychological assessment offer much promise. The Wechsler Intelligence Scale for Children (WISC), since its inception in 1949, has been overwhelmingly the most widely used test of mental ability with the deaf, as with hearing children (Levine, E., *Volta Review*, May, 1974). However, the Verbal IQ, and the subtests upon which it is based, have often proven inappropriate, and typically the Performance IQ has been used as the better indicator of what might be expected of the deaf child. Now that the revised WISC-R has just been published as a much improved test there is a timely opportunity to make the use of this new version more effective by producing standardized norms for our specific population. No such precise modification of the WISC was validated, and speculation and opinion during 25 years have raised some questions with regard to its facile application to the deaf.

To effect this standardization, a representative sample of institutionalized congenitally deaf children, from 6-0-0 to 16-11-30 in age, must be obtained and the whole process of computing scaled scores and Performance IQ's carried out with data from these subjects. Comparison of deaf and hearing norms should provide interesting insights into the dimensions of the tested differences. The sample for standardization must not only be large; it must also be balanced with respect to sex, region, race, parental occupation, the background variables controlled by Wechsler in the original standardization. It must avoid known biasing complications such as the recurrent flare-up of rubella as a confounding factor with the deaf. Therefore, we need to enlist the cooperation of 12-20 sources of subjects.

Institutions with the psychological staffs and resources to do the testing as a part of the continuing program of evaluation of their own clientele are being asked to arrange their schedules of testing so that this project can obtain the data needed. Assistance from schools would involve primarily administering tests, as their schedules allowed during the next 12 months, and completing a very simple questionnaire regarding the subject and testing situation.

The cover letter with this prospectus from President William J. McClure of the Florida School for the Deaf and the Blind solicits your participation in this effort. The Division of Sponsored Research at the University of Florida will also aid, and the North Florida Data Processing Center will be involved in the analysis of the data. Psychologist Frankie J. H. Sisco of the Child Study Center at the St. Augustine D & B School will be Director of the testing in that institution and will coordinate testing with other institutions. In addition to testing and psychological evaluation experience with the deaf, she has had extensive experience testing and working with institutionalized retarded children. Directing technical psychometric phases will be Richard J. Anderson, Ph.D., Professor of Psychology, University of Florida. He has administered large scale testing programs at the University of Michigan and at Florida and constructed the first Drivers License Examinations for the Florida Department of Public Safety and the Highway

Patrol. More detailed explanations will be furnished to all interested institutions, but if you wish to direct any questions to any of the three persons named as sources of information please do so.

All schools participating in this research project will receive recognition for their contributions and will receive reprints of published articles. The success of any project of this magnitude depends upon the assistance and cooperation of professionals who recognize the need. In the hope that you can and will join us in this study a form for your reply is enclosed.

APPENDIX 3
QUESTIONNAIRE TO SCHOOLS

Project to Re-Standardize the WISC-R for the Deaf

Institution invited to participate:

Name: _____

Address: _____

Will your institution assist in the collection of data on the WISC-R?

_____ yes _____ no

Approximately how many congenitally or prelingually deaf children are there in your school?

_____ male _____ female

How many do you expect to test routinely on the WISC-R during the next 12 months?

_____

How many could you test if we supplied the materials?

_____

Is it possible to furnish us with the subjects' WISC-R Record Forms?

_____ yes _____ no

Must the Record Forms be returned after use here?

_____ yes _____ no

Please send this reply to:

Frankie H. Sisco
Child Study Center
The Florida School for the Deaf and the Blind
P.O. Box 1209
St. Augustine, Florida 32084

APPENDIX 4
SCHOOLS PARTICIPATING IN PROJECT

Residential

Mrs. Lynn Cameron, Psychologist
American School for the Deaf
139 N. Main St.
West Hartford, Connecticut 06107

Mr. G. Leon Curtis
Arizona State School for the Deaf and the Blind
P.O. Box 5545
Tucson, Arizona 85703

Mrs. Margaret Eaton
California School for the Deaf
3044 Horace Street
Riverside, California 92506

Mrs. Jean Prince
School Psychologist
California School for the Deaf
2601 Warring Street
Berkeley, California 94704

Mrs. Frankie Sisco, Psychologist
Florida School for the Deaf and the Blind
Post Office Box 1209
St. Augustine, Florida 32084

Mrs. Dorothy F. Kaufmann
Director of Educational Clinical Services
Illinois School for the Deaf
125 Webster
Jacksonville, Illinois 62650

Ms. Susan W. Shults
School Psychologist
Indiana School for the Deaf
1200 East 42nd St.
Indianapolis, Indiana 46205

Mr. J. Day
Office of the Los Angeles County Superintendent of Schools
Division of Special Education
9300 E. Imperial Highway
Downey, California 90242

Mr. Gary Krapf, Psychologist
Marie H. Katzenbach School for the Deaf
Sullivan Way
West Trenton, New Jersey 08625

Mr. Brian F. Alles, Psychologist
Maryland School for the Deaf
Columbia Campus
Post Office Box 894
Columbia, Maryland 21044

Mr. William A. Sherman, Psychologist
Maryland School for the Deaf
Frederick, Maryland 21701

Mr. Ernest E. Haecker, Director
Hearing Test and Child Study Center
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Mr. Larry Porter, Psychologist
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Spartanburg, South Carolina 29302

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Director of Pupil Services
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Day

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Callier School for the Deaf
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P.O. Harvey, Illinois 60426

Ms. Barbara J. Rossier, Psychologist
Taft Aurally Handicapped Program
500 West Keller Street
Santa Ana, California 92707

APPENDIX 5
WISC-R BACKGROUND QUESTIONNAIRE

Project to Re-standardize the WISC-R for the Deaf

	Year	Month	Day
NAME:	DATE TESTED:		
SEX: ____ MALE ____ FEMALE	DATE OF BIRTH:		
RACE: ____ WHITE ____ NONWHITE	AGE:		
SCHOOL:	TITLE:		
EXAMINER:			

Please *check one* in each of the following categories (A thru D):

A. *Occupation of Head of Household:*

____ 1) Professional and technical workers
____ 2) Managers, officials, proprietors, clerical workers and sales workers
____ 3) Craftsmen and foremen
____ 4) Operatives, service workers (including private household), farmers, and farm managers
____ 5) Laborers, farm laborers, and farm foremen

B. *Area of Residence:* ____ Urban ____ Rural

(Communities with 2500 or more inhabitants are defined as Urban and smaller communities as Rural)

C. *Hearing Status of Parents:* ____ Hearing ____ Deaf

D. *Communication method used in the testing situation:*

____ 1) Total Communication
____ 2) Oral Communication (speech only)
____ 3) Fingerspelling with speech
____ 4) Writing
____ 5) Gestures
____ 6) Pantomime
____ 7) Other, specify, if possible _____

Please provide the following psychometric data when available:

WISC Performance IQ _____ Date Adm: _____

Leiter International Performance Scale IQ _____ Date Adm: _____

Hiskey-Nebraska Learning Aptitude Test IQ _____ Date Adm: _____

Examiner comments on back, please.

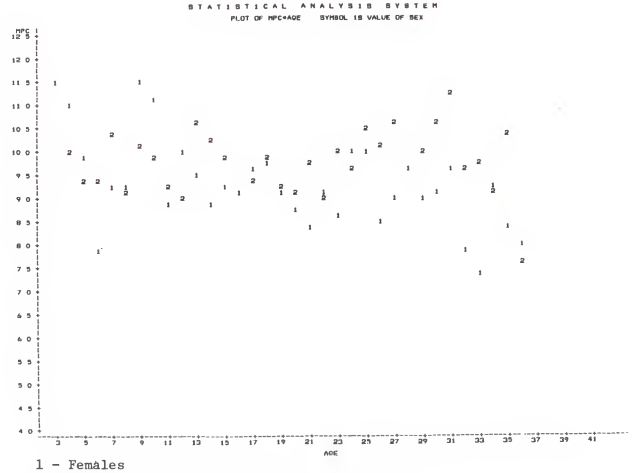
Return this form to: Mrs. Frankie Sisco
FSDB. P.O. Box 1209
St. Augustine. Florida 32084

APPENDIX 6

AGE CODE CONVERSION FOR SCATTERPLOTS OF SUBTESTS

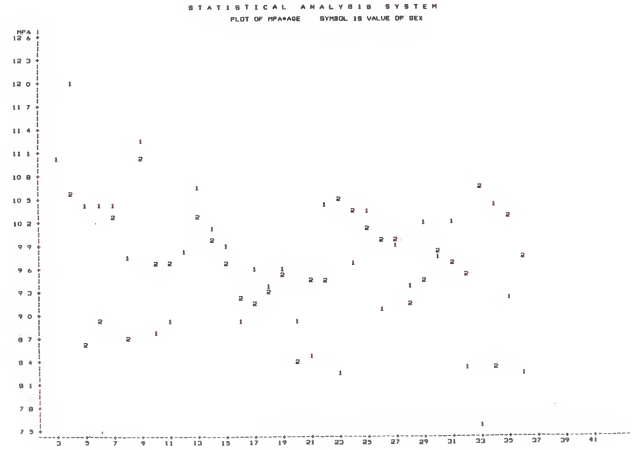
Age	Code
5-8-0 to 5-11-30	3
6-0-0 to 6-3-30	4
6-4-0 to 6-7-30	5
6-8-0 to 6-11-30	6
7-0-0 to 7-3-30	7
7-4-0 to 7-7-30	8
7-8-0 to 7-11-30	9
8-0-0 to 8-3-30	10
8-4-0 to 8-7-30	11
8-8-0 to 8-11-30	12
9-0-0 to 9-3-30	13
9-4-0 to 9-7-30	14
9-8-0 to 9-11-30	15
10-0-0 to 10-3-30	16
10-4-0 to 10-7-30	17
10-8-0 to 10-11-30	18
11-0-0 to 11-3-30	19
11-4-0 to 11-7-30	20
11-8-0 to 11-11-30	21
12-0-0 to 12-3-30	22
12-4-0 to 12-7-30	23
12-8-0 to 12-11-30	24
13-0-0 to 13-3-30	25
13-4-0 to 13-7-30	26
13-8-0 to 13-11-30	27
14-0-0 to 14-3-30	28
14-4-0 to 14-7-30	29
14-8-0 to 14-11-30	30
15-0-0 to 15-3-30	31
15-4-0 to 15-7-30	32
15-8-0 to 15-11-30	33
16-0-0 to 16-3-30	34
16-4-0 to 16-7-30	35
16-8-0 to 16-11-30	36

APPENDIX 7
SCATTERPLOT FOR PICTURE COMPLETION



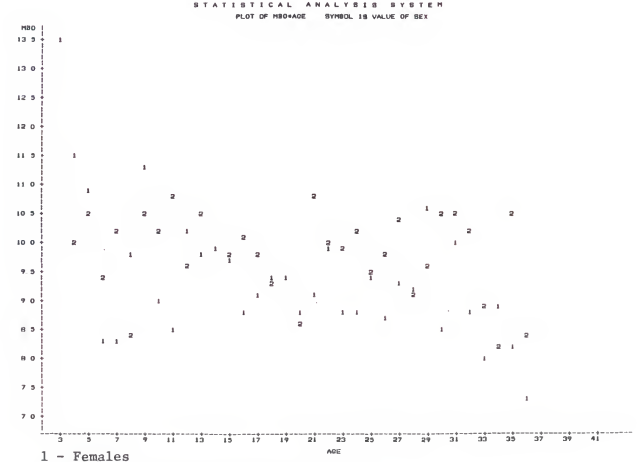
1 - Females
2 - Males
MPC - Mean scaled score for Picture Completion

APPENDIX 8
SCATTERPLOT FOR PICTURE ARRANGEMENT



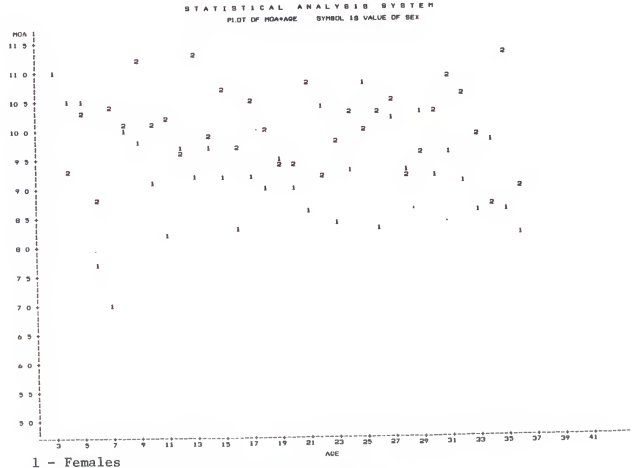
1 - Females
2 - Males
MPA - Mean scaled score for Picture Arrangement

APPENDIX 9
SCATTERPLOT FOR BLOCK DESIGN



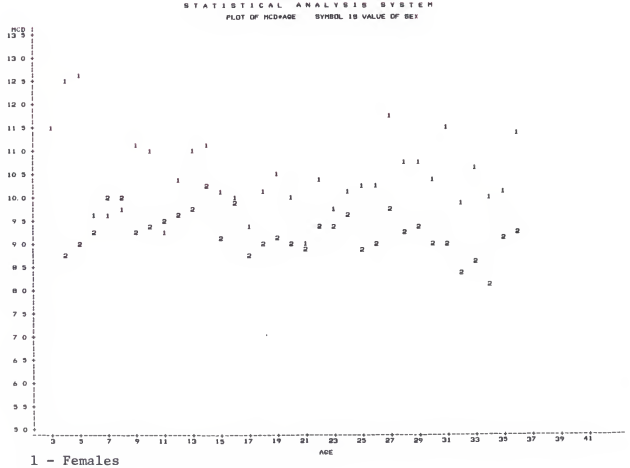
1 - Females
2 - Males
MBD - Mean scaled score for Block Design

APPENDIX 10
SCATTERPLOT FOR OBJECT ASSEMBLY



1 - Females
2 - Males
MOA - Mean scaled score for Object Assembly

APPENDIX 11
SCATTERPLOT FOR CODING



1 - Females
2 - Males
MCD - Mean scaled score for Coding

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BIOGRAPHICAL SKETCH

Frankie Hembree Sisco was born on September 28, 1943, in Aucilla, Florida. She graduated from Cedar Key High School in Cedar Key, Florida, in June, 1960. After graduation, she attended the University of Florida in Gainesville, Florida, where she received her B.A. in psychology in 1965 and her M.Ed. in the psychological foundations of education in 1966.

Mrs. Sisco's work experience includes teaching college courses in psychology and education, working as a psychologist in a large facility serving retarded individuals, and coordinating medical genetics laboratory services for a major medical center. From 1972 until 1980, she worked as a school psychologist at the Florida School for the Deaf and the Blind in St. Augustine, Florida. During this time she undertook projects to improve psychological services for deaf and blind students in the areas of assessment and mental health. She co-authored the Standardization of the WISC-R Performance Scale for Deaf Children and was primary author of a training grant for a Deaf Developmental Play Project which was funded by the National Institute of Mental Health. While at the Florida School for the Deaf and the Blind she was involved with ongoing and experimental group processes with deaf and blind adolescents.

During 1979-80, she conducted a series of regional workshops for the State of Florida, Division of Vocational Rehabilitation, regarding appropriate psychological assessment and therapeutic procedures to be used with deaf individuals. She has published several journal articles and made numerous presentations at state and national meetings in the areas of assessment and mental health services for the deaf.

Mrs. Sisco is a member of the Florida Association of School Psychologists, Florida Psychological Association, National Association of School Psychologists, Southeastern Psychological Association, Convention of American Instructors of the Deaf, and Phi Kappa Phi.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Donald L. Avila, Chairman
Professor of Foundations
of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Barry J. Cuinagh
Associate Professor of
Foundations of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Richard J. Anderson
Professor Emeritus of
Psychology

This dissertation was submitted to the Graduate Faculty of the Department of Foundations of Education in the College of Education and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Chairman, Foundations of Education

Dean for Graduate Studies
and Research

May 1982